

CHEMICAL & METALLURGICAL ENGINEERING

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INTERNATIONAL CHEMICAL ENGINEERING NUMBER—MAY, 1936

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World Perspective of CHEMICAL ENGINEERING

OUT OF THE WORLD WAR, there came but one truly constructive achievement, the building of great chemical industries in the major industrial countries of the World. We in America have realized some of the benefits of this stimulating growth. Other nations have made comparable progress and it is significant that these gains have come, not at the expense of Germany, as is so commonly held, but rather because that country was the first to demonstrate the contributions that chemistry can make to modern civilization.

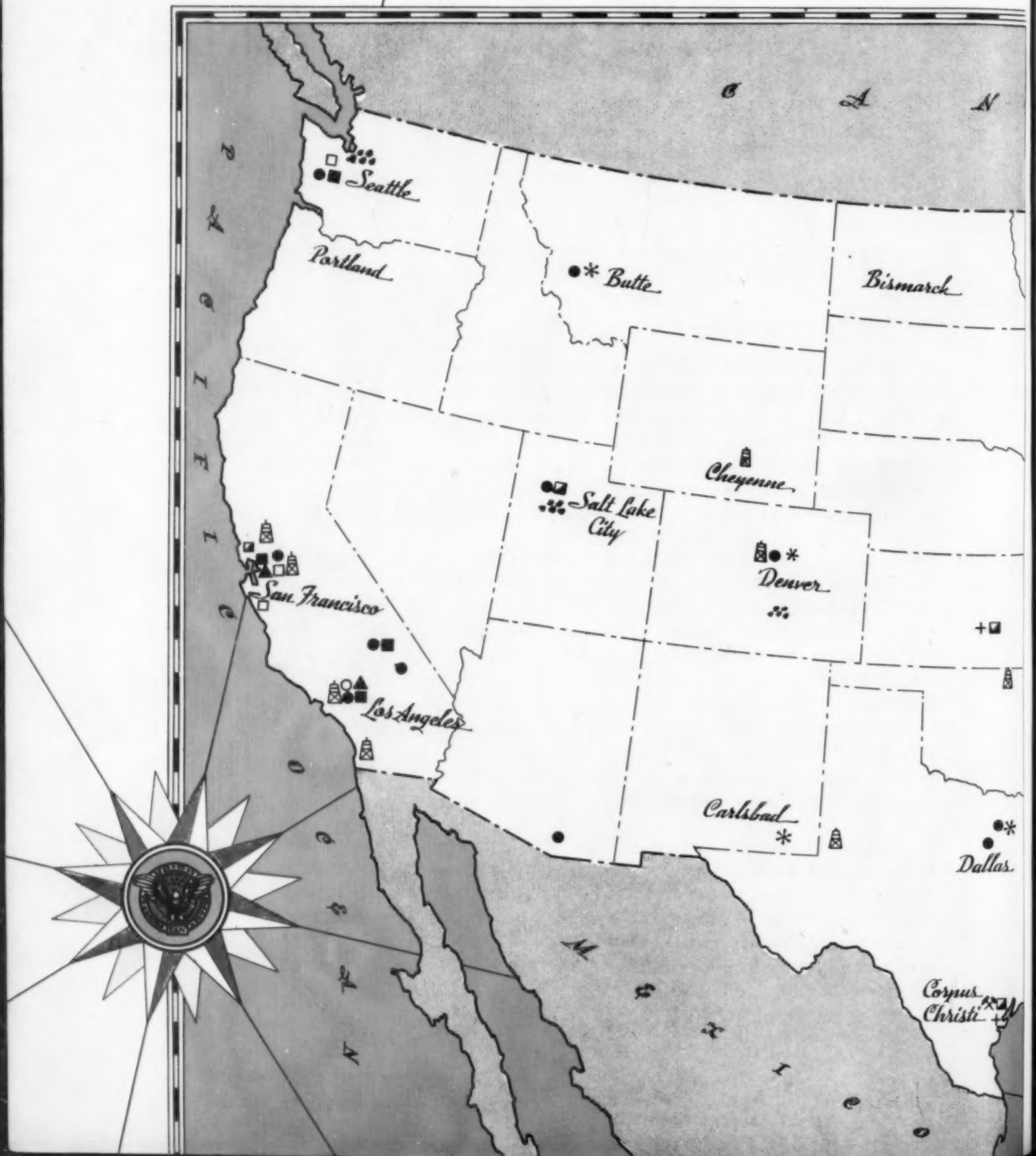
In the busy process of building these industries during the past two decades, there has been a minimum of international cooperation. On the contrary, tariff walls and economic barriers have encouraged isolation and stimulated highly nationalistic programs for self-sufficiency and industrial independence. Lately there is evidence that perhaps we have gone too far in that direction. Many believe it is time that we again take our bearings, chart a saner course on the basis of a broader, world perspective.

Chemical engineering has a vital part to play in that appraisal. Certainly much of our present progress would have been impossible had it not been for the work of the chemical engineer in translating into efficient production the creative contributions of the research chemist. In building for the future, we should welcome, therefore, just such an opportunity as is afforded next month in London when the first International Chemical Engineering Congress will be held under the auspices of the World Power Conference. The Exhibition of the British Plant Manufacturers' Association and the Joint Tour with the Institution of Chemical Engineers will provide additional and effectual agencies for promoting acquaintance, knowledge and better understanding of common problems.

To present an adequate background on which to judge the nature and extent of chemical engineering development throughout the world is the purpose of this first International Issue. If through its maps, articles and illustrations this issue can help to stimulate a new interest in a broader perspective of chemical engineering throughout the world, the combined effort of editors and contributors will have been more than worthwhile.

UNITED STATES

NOT GENERALLY RECOGNIZED is the fact that even prior to the World War, the United States had a chemical industry that accounted for more than a third of the total world production. By 1932 that proportion had increased to 40 per cent while in the same period Germany's share dropped from 24.4 per cent in 1913 to 16 per cent in 1932. In foreign trade, however, the situation was quite different. Both Germany with 28.4



per cent and Great Britain with 15.6 per cent overshadowed America's 10 per cent of the 1913 total. By 1932 our share had increased to 14 per cent, compared with Great Britain's 13.6 and Germany's 28.3 per cent. A larger proportion of American production is for domestic consumption than is the case abroad, but many of our chemical industries are now beginning to look to foreign markets for their future growth.

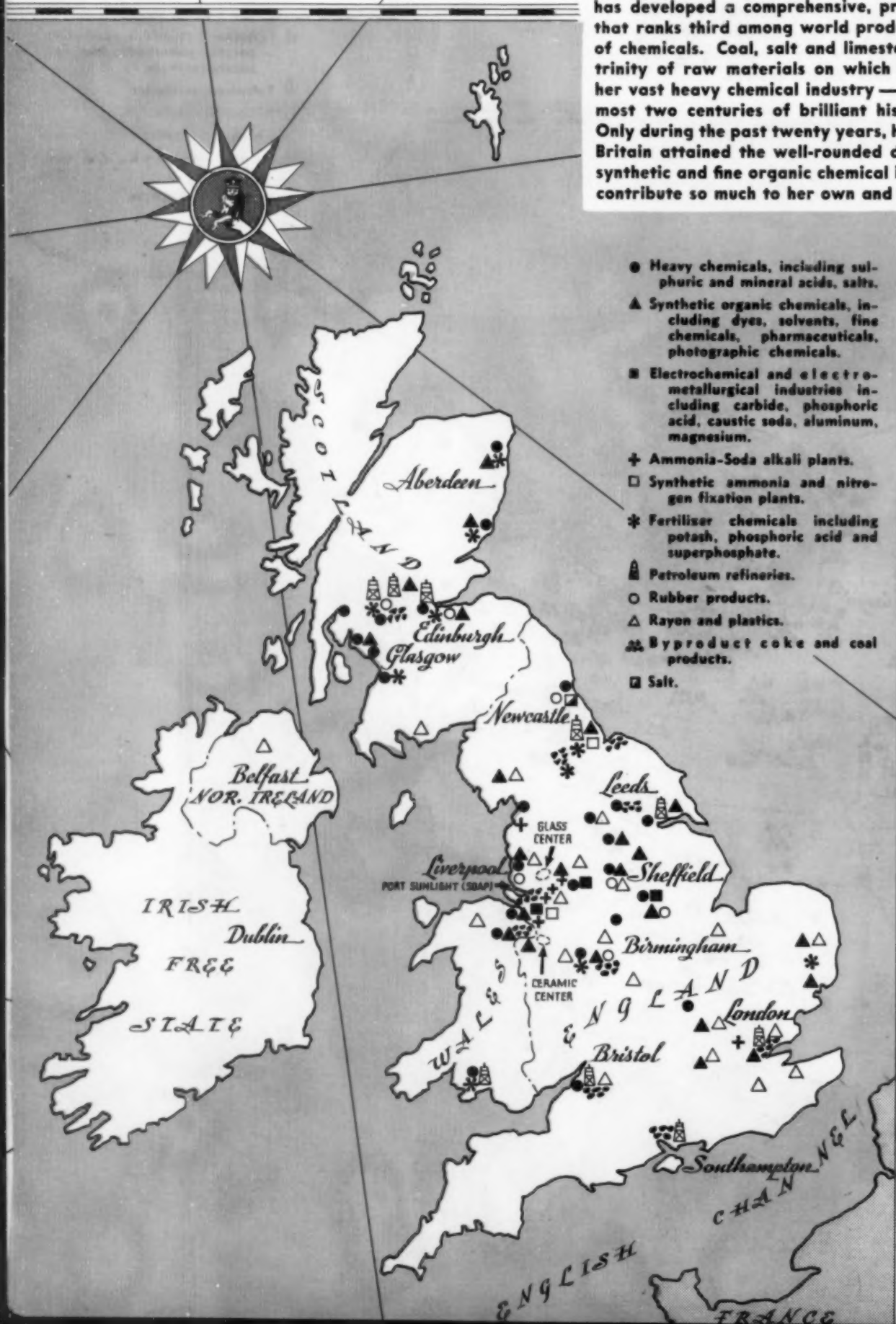


- Heavy chemicals, including sulphuric and mineral acids, salts.
- ▲ Synthetic organic chemicals, including dyes, solvents, fine chemicals, pharmaceuticals, photographic chemicals.
- Electrochemical and electro-metallurgical industries including carbide, phosphoric acid, caustic soda, aluminum, magnesium.
- + Ammonia-Soda alkali plants.
- Synthetic ammonia and nitrogen fixation plants.
- * Fertilizer chemicals, including potash, phosphoric acid and superphosphate.
- ⌚ Petroleum refineries.
- Rubber products.
- △ Rayon and plastics.
- ⌘ Byproduct coke and coal products.
- ✱ Sulphur and pyrites.
- ▣ Salt.

Great Britain

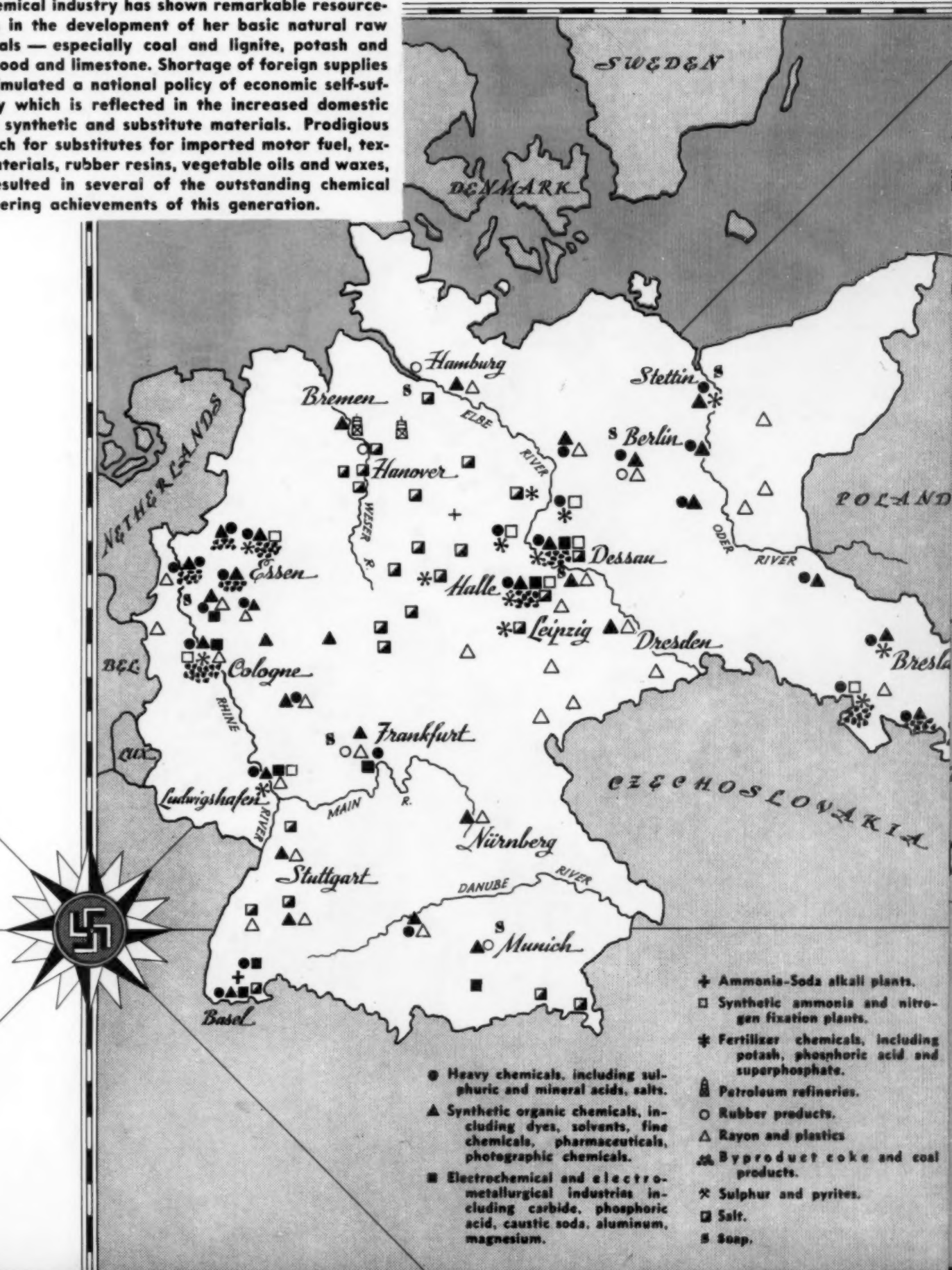
ESSENTIALLY AN INDUSTRIAL NATION which must sell her products in the markets of the world in order to buy vital raw materials and foodstuffs, Great Britain has developed a comprehensive, progressive industry that ranks third among world producers and shippers of chemicals. Coal, salt and limestone form the basic trinity of raw materials on which England first built her vast heavy chemical industry — which now has almost two centuries of brilliant history to its credit. Only during the past twenty years, however, has Great Britain attained the well-rounded development of her synthetic and fine organic chemical industries that now contribute so much to her own and to world progress.

- Heavy chemicals, including sulphuric and mineral acids, salts.
- ▲ Synthetic organic chemicals, including dyes, solvents, fine chemicals, pharmaceuticals, photographic chemicals.
- Electrochemical and electro-metallurgical industries including carbide, phosphoric acid, caustic soda, aluminum, magnesium.
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- ⚙ Petroleum refineries.
- Rubber products.
- △ Rayon and plastics.
- ⚒ Byproduct coke and coal products.
- ▣ Salt.



Germany

GERMANY HAS MAINTAINED her premier position in world trade in chemicals despite competitive development in other industrial nations. While her share in the total world production has declined sharply since 1913, her chemical industry has shown remarkable resourcefulness in the development of her basic natural raw materials — especially coal and lignite, potash and salt, wood and limestone. Shortage of foreign supplies has stimulated a national policy of economic self-sufficiency which is reflected in the increased domestic use of synthetic and substitute materials. Prodigious research for substitutes for imported motor fuel, textile materials, rubber resins, vegetable oils and waxes, has resulted in several of the outstanding chemical engineering achievements of this generation.



FRANCE

FOURTH AMONG THE NATIONS of the world in its production and also in foreign trade in chemicals, the French chemical industry has had its greatest growth during the last two decades — increasing by at least a third since 1914. Synthetic nitrogen, dyes and fine organic chemicals have shown most advance. Valuable raw material supplies from French sources — potash from Alsace, phosphate from Northern Africa, chrome and nickel from New Caledonia — have contributed to this progress. Once characterized by a multiplicity of small, scattered plants, recent trends have been toward larger units, centralized in such chemically important centers as Paris, Marseille, Lyon, Rouen and the North.



ITALY

IN RECENT YEARS Italy's development of her chemical industries has been unusually vigorous. Rapid expansion of facilities for nitrogen fixation and synthetic nitric acid manufacture, in the field of coal-tar derivatives, in the development of domestic sources for motor fuels, and in the production of helium and natural gas, — these have stood Italy in good stead during a most difficult period in her history. Since 1913 her export trade in chemicals has more than doubled, increasing from 2.0 per cent of the world's total to 4.9 per cent in 1932 and to 4.5 per cent in 1934. During the same period, her output, as compared with the total world production of chemicals, mounted from 2.9 per cent in 1913 to 4.0 per cent in 1934. No country in Europe is better equipped with basic natural resources.

- Heavy chemicals, including sulphuric and mineral acids, salts.
- ▲ Synthetic organic chemicals, including dyes, solvents, fine chemicals, pharmaceuticals, photographic chemicals.

- Electrochemical and electro-metallurgical industries including carbide, phosphoric acid, caustic soda, aluminum, magnesium.

- ⊕ Ammonia-Soda alkali plants.

- Synthetic ammonia and nitrogen fixation plants.

- * Fertilizer chemicals, including potash, phosphoric acid and superphosphate.

- ⚡ Petroleum refineries.

- Rubber products.

- △ Rayon and plastics.

- ⚙ Byproduct coke and coal products.

- ✕ Sulphur and pyrites.

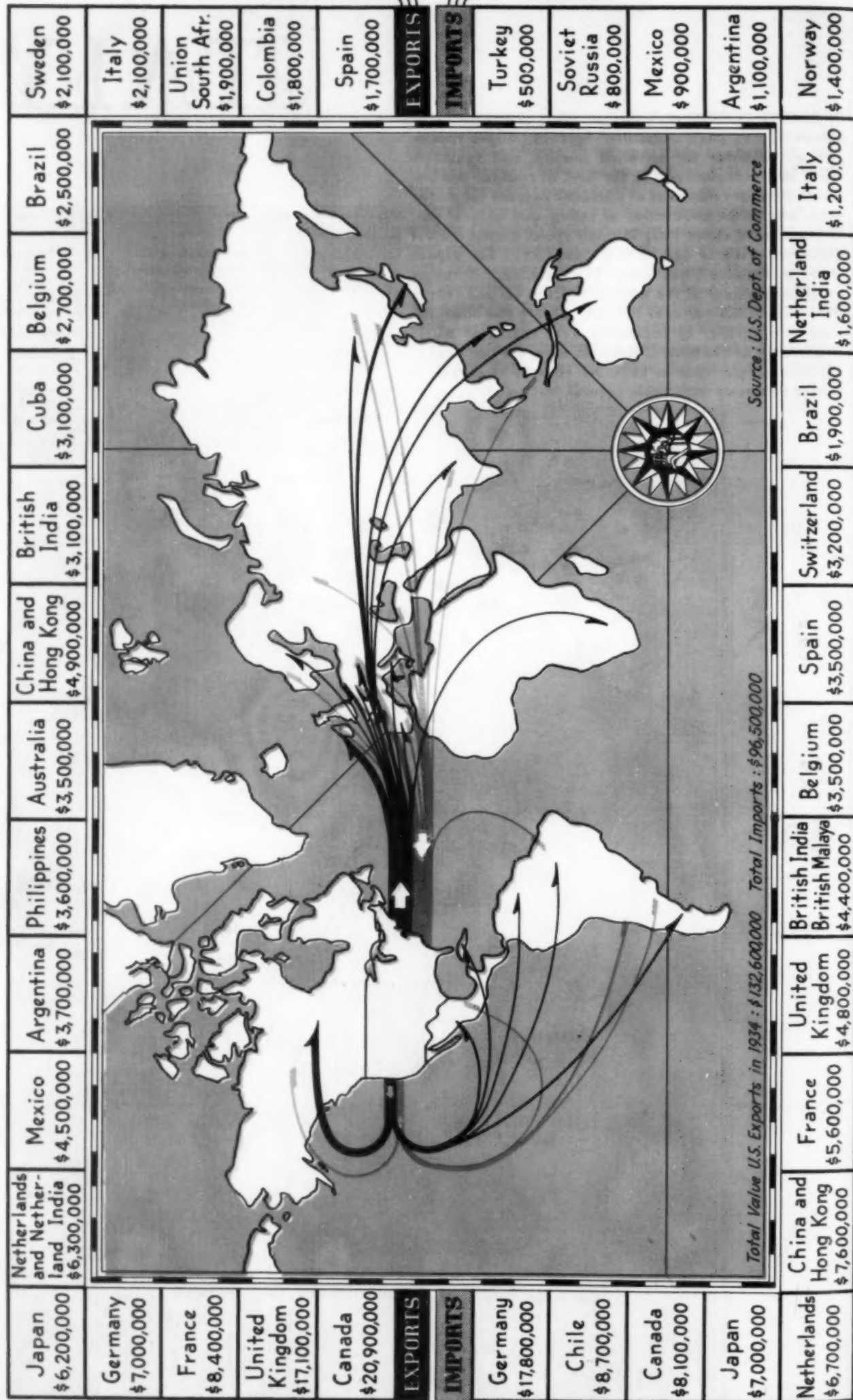
- ▣ Salt.

- B Bauxite.

- M Mercury.



U.S. FOREIGN TRADE IN CHEMICALS



Great Central Hall
in Westminster



ENGLAND Invites

CHEMICAL ENGINEERS of the WORLD

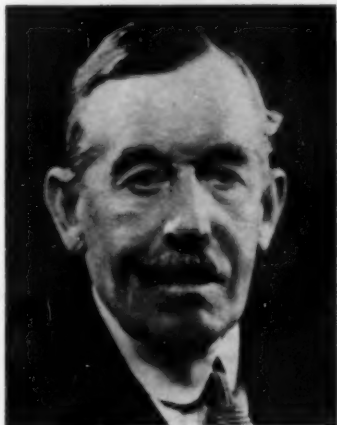
For the First Chemical Engineering Congress, Plant Manufacturers' Exhibition, Joint Tour with British Chemical Engineers, and Annual Meeting of The Society of Chemical Industry

BEFORE his untimely death on December 10, 1933, the late Colonel Sir Frederick Lewis Nathan, K.B.E., past-president of the Institution of Chemical Engineers of Great Britain, had envisioned a great chemical engineering assembly that would unite in common congress not only the forty or more chemical and engineering organizations of his own country, but also the many comparable groups throughout the world. He had observed the benefits gained from similar international conferences in other fields. Happy memories of joint meetings with American colleagues in England in 1925 and the return tour to the United States and Canada in 1928, had spurred him on to a broader program of international cooperation. It is indeed unfortunate that he did not live to enjoy the realization of his great dream which is to be enacted in his native England next month.

For in the great Central Hall, facing Westminster Abbey in London, there will be held during the week of June 22-27 the first international Chemical Engineering Congress. This has been made possible largely by the generous and willing cooperation of the International Executive Committee of the World Power Conference. Since the first power conference was held in London in 1924, this group has efficiently sponsored sectional meetings in Basle (1926), Barcelona, (1929), Tokyo (1929) and Scandinavia (1933) as well as the famous Fuel Conference

in London in 1928 and the second World Power Conference in Berlin in 1930. Its widespread organization has helped materially in developing an outstanding program for this first Chemical Engineering Congress.

More than a hundred papers and discussions have been scheduled for the registered participants from almost a score of countries. The selected subjects cover practically the entire field



SIR DAVID MILNE-WATSON
Knight, Created 1927, M.A., LL.B.,
LL.D. (Hon.), D.L.

Governor of the Gas Light and Coke Co.
and Chairman of the Organizing Committee
of the Chemical Engineering Congress

of activity of the chemical engineer—in research, design, plant construction, operation and management. Engineering education is not neglected. And each author has been repeatedly instructed "to deal as fully as possible with the economic aspects" of his subject. Copies of all papers are to be available for delegates and members prior to the Congress and will later be reprinted, with pertinent discussions, in two or more volumes of transactions. Some indication of their scope is evident from the summary which appears on the following page.

Much of the work of this great project has fallen on the shoulders of the Chairman of the Organizing Committee, Colonel Sir David Milne-Watson, LL.D., D.L., who as directing head of the oldest and largest gas company in the world as well as of many association and group activities, has had invaluable experience to draw upon. Dr. E. W. Smith, C.B.E., is vice-chairman of the committee, comprising sixteen leading engineers and industrialists.

President of the first Chemical Engineering Congress is The Rt.-Hon. the Viscount Leverhulme, assisted by a distinguished corps of vice-presidents. General secretary is Mr. M. W. Burt and the international secretary is Mr. C. H. Gray. The honorary treasurer and chairman of the Finance Committee is Mr. J. Davidson Pratt, O.B.E. The Technical Committee is headed by Mr. W. A. S. Calder, assisted by Dr. F. S. Sinnatt, C.B., M.B.E.

SUMMARY OF PROGRAM FOR INTERNATIONAL CHEMICAL ENGINEERING CONGRESS, LONDON, JUNE 22-27, 1936

SECTION A: Ferrous Metals in Chemical Plant Construction.

Seven papers from Great Britain, Holland and the United States deal with steel forgings, heat-, rust-, and acid-resisting alloys.

SECTION B: Refractories, Rubber, Plastics and Other Materials in Chemical Plant Construction.

Canada, France, Germany, Great Britain, Japan, Sweden, and the United States are represented by twelve papers on chemical stoneware, insulating materials, fibers, aluminum and non-ferrous metals and alloys.

SECTION C: Separation.

Coal washing, distillation, benzol recovery, filtration, cracking of petroleum, spray and solids drying, solvent extraction and crystallization, are all included in twenty papers from France, Holland, Germany, Great Britain, Poland, Sweden, Russia and the United States.

SECTION D: Size Reduction, Grading and Mixing, Electrolysis and Electrical Applications.

Ten papers contributed by chemical engineers from Canada, Denmark, Germany, Holland, Japan and Sweden, cover a wide range of subjects—from hydro-electric power development to anodic oxidation and metal deposition.

SECTION E: Destructive Distillation.

Austria, Germany, Great Britain, Hungary, Japan, Russia, Sweden, Switzerland and the United States are all represented in a dozen papers on coal, lignite and wood carbonization, gas manufacture and tar distillation.

SECTION F: Treatment and Disposal of Effluents and Waste Materials, Lubrication.

Five papers on industrial and trade waste problems and two on lubricating oil refining processes have been prepared by representatives from Canada, Denmark, Great Britain, Holland and the United States.

SECTION G: High Pressure Reactions and High Vacuum.

Germany, Great Britain, Japan and the United States contribute six papers in this important field of technology.

SECTION H: Heat Exchange.

Evaporation, waste-heat recovery, induction electric heating and a group of seven other papers on various phases of heat transfer are offered from Austria, Germany, Great Britain, Sweden and the United States.

SECTION J: Education and Training.

Here educators from Austria, Germany, Great Britain, Japan and the United States discuss in five papers the education and training of chemical engineers in their respective countries.

SECTION K: Statistics, Administration, Safety and Welfare.

Seven papers from Germany, Great Britain and the United States deal with occupational risks, statistical and cost methods of control, economic considerations in formulating chemical engineering projects.

SECTION L: Trends of Development.

A group of thirteen papers from Austria, Denmark, Great Britain, Japan, Germany and Russia reflect advances over a wide front—from fermentation in Austria and fumigation in Great Britain to lager beer in Denmark and frozen food in Japan.

SECTION M: General Aspects.

Here such important considerations as fundamental and applied research, process and apparatus development and standardization and raw material resources and development are discussed in eleven papers from Austria, Canada, Germany, Great Britain, Japan, Russia and the United States.

BRITISH CHEMICAL PLANT EXHIBITION

HELD SIMULTANEOUSLY and in the same building as the international Chemical Engineering Congress of the World Power Conference there will be a comprehensive exhibition of recent British developments in the field of chemical engineering equipment. The British Chemical Plant Manufacturers' Association sponsored a similar exhibition in July, 1931, in connection with the Jubilee celebrations of the Society of Chemical Industry. Since that time there have been a great many advances that should be of interest to chemical engineers not only in Great Britain but throughout the world.

Approximately fifty manufacturers covering the whole range of British "chemical plant" have reserved space for their exhibits. In addition there will be a number of governmental and association exhibits such as that being organized by the British Department of Scientific and Industrial Research to show the benefits of scientific research in industry with special reference to chemical engineering. The subjects dealt with in this exhibit will include coal and its byproducts, iron and steel, high-pressure technology, heat transmission, the efficiency of pipe covering materials, corrosion-resisting alloys, water purification and softening, a new



J. DAVIDSON PRATT, O.B.E.

General Manager and Secretary of Association of British Chemical Manufacturers, Secretary of British Chemical Plant Manufacturers' Association, Hon. Treasurer and Chairman of Finance Committee of Chemical Engineering Congress

type of ether extractor and its applications, heat treatment of flour, the effect of paint on illumination, the use of rubber and refractories in chemical engineering. A number of these will be further illustrated by a series of short films.

The governmental exhibit is a co-

operative one in which a number of research stations of the Department and industrial research associations are to contribute. The following is a list of the organizations concerned:

The National Physical Laboratory, the Fuel Research Station, The Chemical Research Laboratory, The Water Pollution Research Board, The Research Association of British Paint, Colour and Varnish Manufacturers, The Research Association of British Flour Millers, The Research Association of British Rubber Manufacturers, the British Non-Ferrous Metals Research Association, The Industrial Research Council of the British Iron and Steel Federation, The British Cast Iron Research Association, The British Electrical and Allied Industries Research Association and The British Leather Manufacturers' Association.

The Exhibition will be opened at 11 a.m. on Monday, June 22, in the Great Hall of the Central Hall in Westminster. The Official opening will be followed by an official tour of the Exhibition and an Inaugural Luncheon at the Hotel Victoria. Invitations have been extended to prominent foreign delegates to the Congress, leading scientists, business men and representatives of governmental departments.

JOINT MEETING AND TOUR OF BRITISH AND AMERICAN CHEMICAL ENGINEERS

DIRECTLY following the Chemical Engineering Congress and Chemical Plant Exhibition, the Institution of Chemical Engineers has invited the members of the American Institute of Chemical Engineers and their registered guests to join in an eight-day tour of Central England and Wales. Important centers of chemical industry are to be visited but no technical program has been arranged and the whole tour has been planned in the nature of a pleasant holiday during which there will be a better opportunity for developing friendly contacts and acquaintances. Many American chemical engineers will recall a similar tour of important chemical centers of the United States and Canada which was made with British colleagues in 1928.

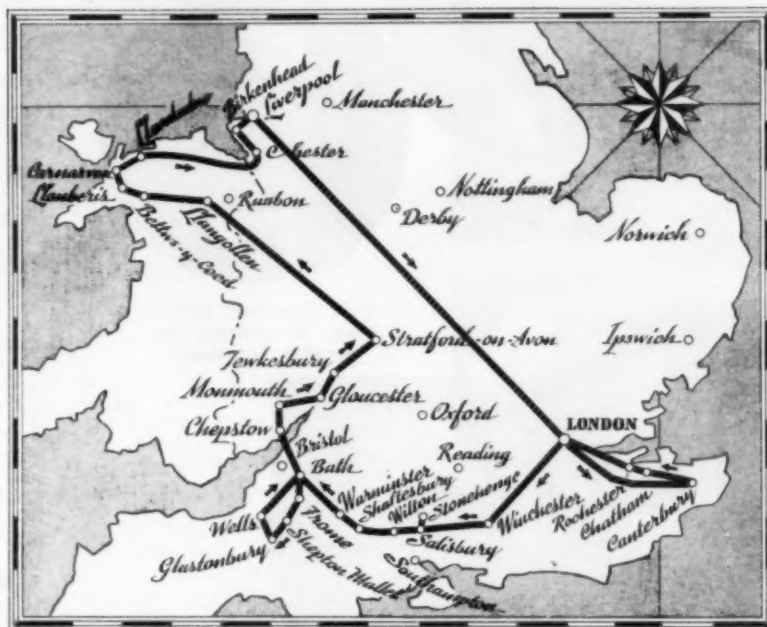
The tour starts on Sunday, June 28, with a day of sightseeing in Canterbury, continuing via Chatham to Rochester for tea and returning to London via places associated with the life of Charles Dickens. Next day the party entrains for Winchester for sightseeing and afternoon tea at the Royal Hotel. Leaving Winchester by coach the party proceeds via New Forest, Romsey, Ouer, Cadman, Lyndhurst and Ringwood to Salisbury. A dance is provided that evening at the County Hotel.

On Tuesday, June 30, following a sunrise visit to Stonehenge and an inspection of the Salisbury Cathedral, the party leaves by coach to Bath via Wilton, Shaftesbury and Warminster. The following morning will be spent in sightseeing with an afternoon trip to Glastonbury and Wells via Frome and Shepton Mallet.

Thursday, July 2, finds the group in Chepstow ready to leave in the afternoon for a motor tour to Gloucester via Tinterton and Monmouth, thence across the Forest of Dean. From Gloucester the party goes to Tewkesbury for tea, continuing via Pershore to

Stratford-on-Avon to witness a special performance of "Julius Caesar" at the Shakespeare Memorial Theatre.

The next day a special train takes the party to Llangollen and again by coach to Llanberis via Bettws-y-Coed, Capel Curig, and Pen-y-Gwryd and back to Llanberis, continuing by coach via Caernarvon, Bangor and Conway to Llandudno. From here a trip is made to Chester through the industrial area and a visit to Eaton Hall, the home of the Duke of Westminster. That evening a farewell carnival dinner will be given at the Grosvenor Hotel, and the next day the party proceeds by coach to Liverpool via Birkenhead and Mersey Tunnel.



Liverpool Meeting S.C.I.

SOCIETY of Chemical Industry has invited all members of the American delegation to attend the society's general annual meeting in Liverpool, July 6 to 10, inclusive. A fine program has been outlined for both technical sessions and social occasions. The meeting opens Tuesday, July 7, with the president's address by Mr. W. A. S. Calder, Esq., with a civil reception that evening at the Town Hall by the Lord Mayor of Liverpool. The plastics group holds its first session Wednesday, July 8, followed by works visits to some of the larger chemical industries in the Liverpool-Manchester area.

LIST OF EXHIBITORS AT BRITISH CHEMICAL PLANT MANUFACTURERS' EXHIBITION

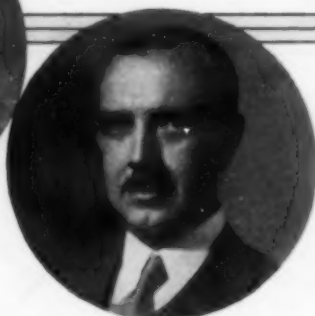
A.7 and 9....The Aluminum Plant & Vessel Co. Ltd.	A.6 Firth Vickers Stainless Steels Ltd.	B.16 R. Marsh & Co.
B.5 Ashmore, Benson, Pease & Co. Ltd.	A.5 Grant & West Ltd.	B.17 The Mond Nickel Co. Ltd.
B.2 Audley Engineering Co., Ltd.	B.3 Hadfields Ltd.	B.15 Negretti & Zambra
B.23 and 28...Henry Balfour & Co. Ltd.	A.11 Hathernware Ltd.	B.31 The Pascall Engineering Co. Ltd.
A.12 Bennett Sons & Shears Ltd.	A.4 Leonard Hill Ltd.	A.19 Premier Colloid Mills Ltd.
B.4 and 6 British Gas Federation	A.13 The Hydronyl Syndicate Ltd.	B.9 Saunders Valve Co. Ltd.
B.20 The British Oxygen Co. Ltd.	A.18 "The Industrial Chemist."	B.23 and 28 .. George Scott & Son (London) Ltd.
A.15 Thomas Broadbent & Sons Ltd.	B.22 International Combustion Ltd.	B.25 Siebe, Gorman & Co. Ltd.
B.30 Brown Bayleys Steel Works Ltd.	B.19 The International Electrolytic Plant Co.	B.11 George Skey & Co. Ltd.
A.10 Cannon Iron Foundries Ltd.	B.8 S. H. Johnson & Co. Ltd.	B.26 Society of Chemical Industry
B.29 "The Chemical Age"	A.17 George Kent Ltd.	A.16 Stevens & Manning
A.3 T. & C. Clark & Co. Ltd.	A.1 Kestner Evaporator & Engineering Co. Ltd.	A.2 The Tintometer Ltd.
B.21 and 24 .. Dorr-Oliver Co. Ltd.	B.14 H. K. Lewis & Co. Ltd.	B.27 Tungstone Patent High Pressure Die Casting Co.
B.12 Doulton & Co. Ltd.	B.13 Thos. Locker & Co. Ltd.	B.7 United Steel Companies Ltd.
B.23 and 28...Enamelled Metal Products Corporation (1933) Ltd.	A.14 Manesty Machines Ltd.	B.32 United Water Softeners Ltd.
	B.18 Manlove Allott & Co. Ltd.	B.1 Watson, Laidlaw & Co. Ltd.

WHO'S WHO

IN THE AMERICAN



Martin H. Ittner,
president, A.I. Ch.E.



A. E. Marshall, chair-
man, Committee on
English Meetings



Frederick J. LeMaistre,
secretary and execu-
tive secretary, A.I.
Ch.E.



Fred C. Zeisberg, vice-
president, A.I.Ch.E.



1 Roger Adams, head,
department of chemistry
and chemical engineer-
ing, University of Illi-
nois, Urbana, Ill., and
retiring president of the
American Chemical So-
ciety. (Guest)



2 Jos. W. Ayers, direc-
tor of research, C. K.
Williams & Co., Easton,
Pa. (Member)



3 Leo. H. Baekeland,
president, Bakelite
Corp., New York, N. Y.,
and past-president,
American Institute of
Chemical Engineers.
(Member)



4 Joseph Bancroft,
chairman of board,
Joseph Bancroft & Sons
Co., Wilmington, Del.
(Member)



5 P. S. Barnes, manager
of sales, chemical divi-
sion, Pfaudler Co.,
Rochester, N. Y. (Mem-
ber)



6 Edward Bartow, head,
department of chemis-
try and chemical engi-
neering, University of
Iowa; president, Ameri-
can Chemical Society;
and director, American
Institute of Chemical
Engineers; Iowa City,
Iowa. (Member)



7 R. I. Bashford, as-
sistant to vice-president,
Atlas Powder Co., Phil-
adelphia, Pa. (Member)



8 J. L. Bennett, chemi-
cal engineer, Hercules
Powder Co.; and direc-
tor, American Institute
of Chemical Engineers,
Wilmington, Del.
(Member)



9 Ernst Berl, research
professor of chemical
engineering, Carnegie
Institute of Technology,
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ber)

10 E. K. Bolton, chemi-
cal director, E. I. du
Pont de Nemours & Co.,
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(Member)

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ment faculty, College of
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rector of research,
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(Member)

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cal Products Co., De-
troit, Mich. (Member)

14 Harlow Bradley,
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France, Paris. (Mem-
ber)

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Merck & Co., Philadel-
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ufacturing division, B.
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Ohio. (Member)

18 A. D. Chambers,
manager, dyestuffs divi-
sion, organic chemi-
cals department, E. I.
duPont de Nemours &
Co., Wilmington, Del.
(Member)

19 R. B. Chillias, Jr.,
distillation engineer, At-
lantic Refining Co.,
Philadelphia, Pa. (Mem-
ber)

20 Charles E. Coates,
dean of College of Pure
and Applied Science and
director of Institute of
Industrial Research,
chemical department,
Louisiana State Univer-
sity, Baton Rouge, La.
(Member)

DELEGATION*

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22 C. R. DeLong, consulting chemical engineer, and treasurer of the American Institute of Chemical Engineers, New York, N. Y. (Member)

23 Barnett F. Dodge, professor of chemical engineering and chairman of department, Yale University, New Haven, Conn. (Member)

24 J. V. N. Dorr, president, Dorr Co., and past-president of the American Institute of Chemical Engineers, official delegate to World Power Conference appointed by U. S. Department of State, New York, N. Y. (Member)

25 Willard H. Dow, president and general manager, Dow Chemical Co., Midland, Mich. (Member)

26 Gaston F. DuBois, vice-president in charge of research and development, Monsanto Chemical Co., St. Louis, Mo. (Member)

27 W. W. Duecker, research fellow Mellon Institute of Industrial Research, Pittsburgh, Pa. (Member)

28 T. L. Dunbar, president, Chemipulp Process, Inc., Watertown, N. Y. (Member)

29 Gustav Egloff, director of research, Universal Oil Products Co.; and director, American Institute of Chemical Engineers, Chicago, Ill. (Member)

30 Frank R. Eldred, director of research, Reed & Carnick, Jersey City, N. J. (Member)

31 Carleton Ellis, president, Ellis Laboratories, Montclair, N. J. (Member)

32 G. J. Esselen, president, Gustavus J. Esselen, Inc.; and director, American Institute of Chemical Engineers, Boston, Mass. (Member)

33 Andrew M. Fairlie, consulting chemical engineer, Tennessee Corp., Farmers Fertilizer Co., American Zinc, Lead, & Smelting Co., Atlanta, Ga. (Member)

34 W. W. Farnum, chief chemist, Naval Powder Factory, Indian Head, Md. (Member)

35 Crosby Field, president, Flak-Ice Corp.; and vice-president, Brill Co., Brooklyn, N. Y. (Member)

36 Francis C. Frary, director of research, Aluminum Co. of America, New Kensington, Pa. (Member)

37 W. L. Gomory, consulting chemical engineer, New York and Paris. (Member)

38 H. C. Graebner, Fabrikoid Division, E. I. duPont de Nemours & Co., Newburgh, N. Y. (Guest)

39 C. A. Grasselli, II, manager of European operations, development department, E. I. duPont de Nemours & Co., Inc., Wilmington, Del. (Member)

40 Philip H. Groggins, senior chemist, Color and Farm Waste Division, U. S. Department of Agriculture, Washington, D. C. (Member)

41 J. Stuart Groves, chemical engineer, control division, dyestuffs department, E. I. duPont de Nemours & Co., Inc., Wilmington, Del. (Member)

42 Ivan Gubelmann, chemical director, organic chemical department, E. I. duPont de Nemours & Co., Inc., Wilmington, Del. (Member)

43 Adolph Harvitt, vice-president, Magnetic Pigment Co., Trenton, N. J. (Member)

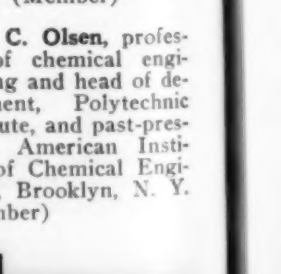
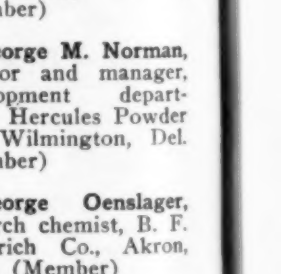
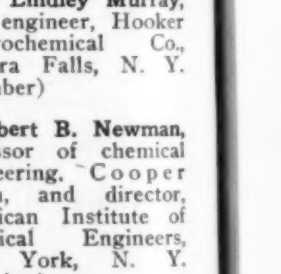
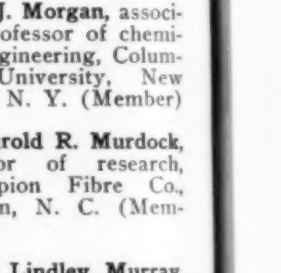
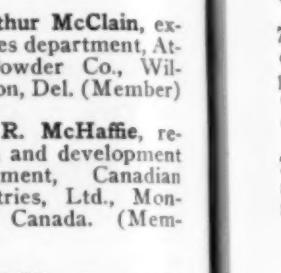
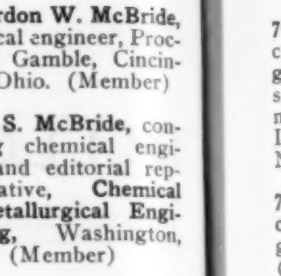
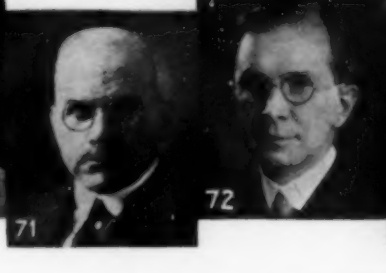
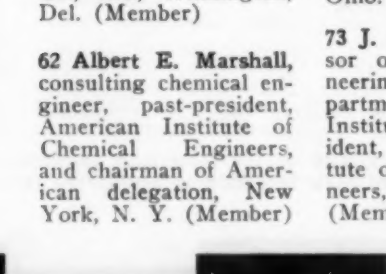
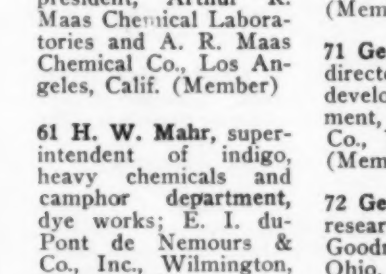
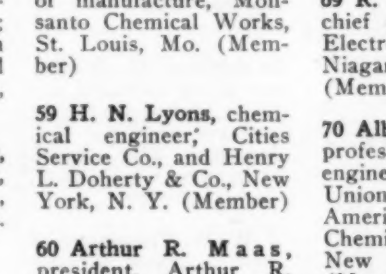
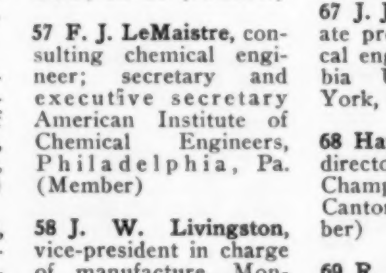
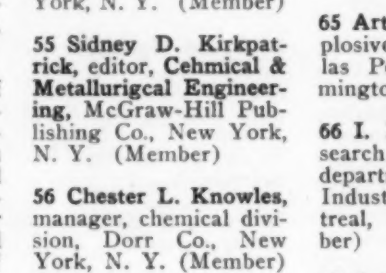
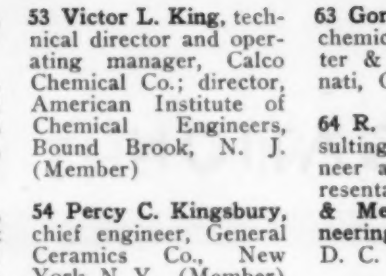
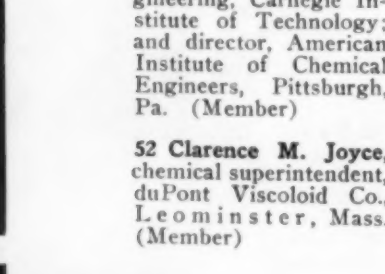
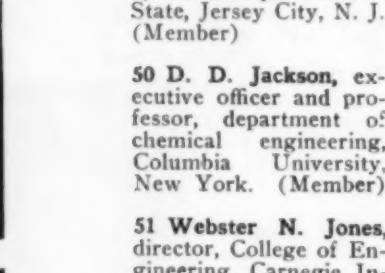
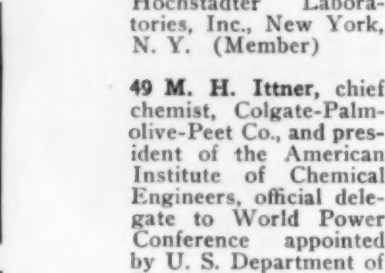
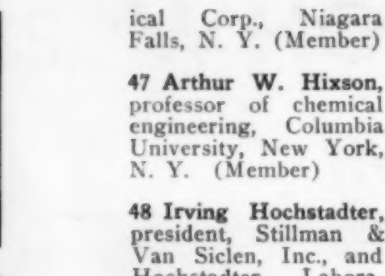
44 H. H. Heller, operating superintendent, chlorine department, Kimberly Clark Corp., Neenah, Wis. (Member)

45 H. D. Hellmers, West End Chemical Co., Westend, Calif. (Guest)

46 C. J. Herrly, sales manager, Niacet Chem-



*Members and guests of the American Institute of Chemical Engineers who have indicated their intention to attend the International Chemical Engineering Congress.



ical Corp., Niagara Falls, N. Y. (Member)

47 Arthur W. Hixson, professor of chemical engineering, Columbia University, New York, N. Y. (Member)

48 Irving Hochstadter, president, Stillman & Van Siclen, Inc., and Hochstadter Laboratories, Inc., New York, N. Y. (Member)

49 M. H. Ittner, chief chemist, Colgate-Palmolive-Peet Co., and president of the American Institute of Chemical Engineers, official delegate to World Power Conference appointed by U. S. Department of State, Jersey City, N. J. (Member)

50 D. D. Jackson, executive officer and professor, department of chemical engineering, Columbia University, New York. (Member)

51 Webster N. Jones, director, College of Engineering, Carnegie Institute of Technology; and director, American Institute of Chemical Engineers, Pittsburgh, Pa. (Member)

52 Clarence M. Joyce, chemical superintendent, duPont Viscoloid Co., Leominster, Mass. (Member)

53 Victor L. King, technical director and operating manager, Calco Chemical Co.; director, American Institute of Chemical Engineers, Bound Brook, N. J. (Member)

54 Percy C. Kingsbury, chief engineer, General Ceramics Co., New York, N. Y. (Member)

55 Sidney D. Kirkpatrick, editor, *Chemical & Metallurgical Engineering*, McGraw-Hill Publishing Co., New York, N. Y. (Member)

56 Chester L. Knowles, manager, chemical division, Dorr Co., New York, N. Y. (Member)

57 F. J. LeMaistre, consulting chemical engineer; secretary and executive secretary American Institute of Chemical Engineers, Philadelphia, Pa. (Member)

58 J. W. Livingston, vice-president in charge of manufacture, Monsanto Chemical Works, St. Louis, Mo. (Member)

59 H. N. Lyons, chemical engineer; Cities Service Co., and Henry L. Doherty & Co., New York, N. Y. (Member)

60 Arthur R. Maas, president, Arthur R. Maas Chemical Laboratories and A. R. Maas Chemical Co., Los Angeles, Calif. (Member)

61 H. W. Mahr, superintendent of indigo, heavy chemicals and camphor department, dye works; E. I. duPont de Nemours & Co., Inc., Wilmington, Del. (Member)

62 Albert E. Marshall, consulting chemical engineer, past-president, American Institute of Chemical Engineers, and chairman of American delegation, New York, N. Y. (Member)

63 Gordon W. McBride, chemical engineer, Procter & Gamble, Cincinnati, Ohio. (Member)

64 R. S. McBride, consulting chemical engineer and editorial representative, *Chemical & Metallurgical Engineering*, Washington, D. C. (Member)

65 Arthur McClain, explosives department, Atlas Powder Co., Wilmington, Del. (Member)

66 I. R. McHaffie, research and development department, Canadian Industries, Ltd., Montreal, Canada. (Member)

67 J. J. Morgan, associate professor of chemical engineering, Columbia University, New York, N. Y. (Member)

68 Harold R. Murdock, director of research, Champion Fibre Co., Canton, N. C. (Member)

69 R. Lindley Murray, chief engineer, Hooker Electrochemical Co., Niagara Falls, N. Y. (Member)

70 Albert B. Newman, professor of chemical engineering, Cooper Union, and director, American Institute of Chemical Engineers, New York, N. Y. (Member)

71 George M. Norman, director and manager, development department, Hercules Powder Co., Wilmington, Del. (Member)

72 George Oenslager, research chemist, B. F. Goodrich Co., Akron, Ohio. (Member)

73 J. C. Olsen, professor of chemical engineering and head of department, Polytechnic Institute, and past-president, American Institute of Chemical Engineers, Brooklyn, N. Y. (Member)

74 Donald F. Othmer, consulting chemical engineer, assistant professor of chemical engineering, Polytechnic Institute, Brooklyn, N. Y. (Member)

75 Charles S. Palmer, consulting chemical engineer, Pittsburgh, Pa. (Member)

76 Frank S. Pollock, director of high explosives, Atlas Powder Co., Wilmington, Del. (Member)

77 J. T. Power, manager, development and research, Atlas Powder Co., Wilmington, Del. (Member)

78 D. A. Pritchard, production manager, chemical group, Canadian Industries, Ltd., Montreal, Canada. (Member)

79 W. P. Putnam, president and general manager, Detroit Testing Laboratory, Detroit, Mich. (Member)

80 Edgar M. Queeny, president, Monsanto Chemical Co., St. Louis, Mo. (Guest)

81 E. E. Randolph, professor of chemical engineering, North Carolina State College of Agriculture and Engineering, Raleigh, N. C. (Member)

82 Charles L. Reese, director, E. I. duPont de Nemours & Co., Inc.; and past-president, American Institute of Chemical Engineers, Wilmington, Del. (Member)

83 E. G. Robinson, general manager, organic chemicals department, E. I. duPont de Nemours & Co.; and, president, Kinetic Chemicals, Inc., Wilmington, Del. (Member)

84 R. P. Rose, executive department, U. S.

Rubber Co., New York, N. Y. and London. (Member)

85 J. L. Schueler, superintendent, steel and wire division, Continental Steel Corp., Kokomo, Ind. (Member)

86 W. V. Sessions, associate professor of chemistry, Wayne University, Detroit, Mich. (Member)

87 Foster D. Snell, president and consulting chemical engineer, Foster D. Snell, Inc., Brooklyn, N. Y. (Member)

88 Arthur L. Stern, sales representative, Pulverizing Machinery Co., General Machine Co., Springfield Facing Co., West Orange, N. J. (Member)

89 Earl P. Stevenson, president and director, Arthur D. Little, Inc., Newton, Mass. (Member)

90 C. M. A. Stine, vice-president in charge of research, E. I. duPont de Nemours & Co., Inc., Wilmington, Del. (Member)

91 E. A. Taylor, director of research, Grasselli Chemical Co., Cleveland, Ohio. (Member)

92 S. L. Tyler, chemical engineer, Thermal Syndicate, Ltd., Garden City, N. Y. (Member)

93 James G. Vail, vice-president and chemical director, Philadelphia Quartz Co.; and director, American Institute of Chemical Engineers, Philadelphia, Pa., chairman, American Section, Society of Chemical Industry. (Member)

94 A. McLaren White, head, department of chemical engineering, University of North Carolina, Chapel Hill, N. C. (Member)

95 W. G. Whitman, head, department of chemical engineering, Massachusetts Institute of Technology, Cambridge, Mass. (Member)

96 R. E. Wilson, vice-chairman, Pan American Petroleum & Transport Co., New York, N. Y. (Member)

97 R. I. Wishnick, president, Wishnick-Tumpeer, Inc., New York, N. Y. (Member)

98 James R. Withrow, consulting chemical engineer, chairman of department and professor of chemical engineering, Ohio State University; and director, American Institute of Chemical Engineers, Columbus, Ohio. (Member)

99 Hood Worthington, research chemical engineer, E. I. duPont de Nemours & Co., Wilmington, Del. (Member)

100 F. C. Zeisberg, technical investigator, development department, E. I. duPont de Nemours & Co.; and vice-president, American Institute of Chemical Engineers, Wilmington, Del. (Member)



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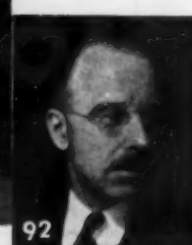
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Great Britain



Words of cordial welcome and friendly greetings to
American chemical engineers and industrialists
from outstanding leaders in British industry

CHEMICAL ENGINEERING'S ROLE IN BRITISH INDUSTRY

By **SIR HARRY MCGOWAN,**
K.B.E., LL.D., D.C.L.

Chairman of Imperial Chemical Industries

IT GIVES me pleasure to extend a welcome to the American chemical engineers who are coming to London for the International Chemical Engineering Congress. Apart from the international goodwill and co-operation among chemical engineers which such visits are likely to promote, there is the material advantage to be gained from the fullest possible interchange of technical knowledge between the great producing countries of the world.

The importance of the part played by the chemical engineer in industry cannot be over-estimated. Each year he

builds more securely on the foundations laid by the research chemist. My own company provides at least two outstanding recent illustrations of his work. The development of the synthetic-ammonia plant at the Billingham factory of I.C.I. is one; the other is a more spectacular and later development at the same factory—the successful production of petrol by the hydrogenation of bituminous coal—which has followed directly upon the pooling of international technical resources and close collaboration with chemical engineers and metallurgists. The coal hydrogenation plant particu-

larly necessitated much intensive research of this dual character to develop steels able to withstand the enormously high pressures and temperatures in the process.

Although the Chemical Engineering Congress of the World Power Conference to be held in June of this year will be international, the exhibition of chemical plant to be held simultaneously will be confined to British plant. American visitors will thus have an opportunity of seeing what progress has been made in the United Kingdom since the last exhibition in 1931.

SCIENCE IS INTERNATIONAL

THE Chemical Engineering Congress to be held in connection with the World Power Conference, will be one of those occasions which illustrates the truth of the old saying that "Science is International." A vital factor in progress throughout history has been the interchange of scientific knowledge. In the twentieth century, particularly, we have become accustomed to the regular interchange of information as to new processes and discoveries and the increasing growth of international rationalization of industry has intensified this process.

It will be with great pleasure that we

shall welcome to this Congress in London those representative chemical engineers and industrialists of America who come to visit us and to give us the benefit of their knowledge and experience in our discussion. It is my hope that I shall have an opportunity of meeting some of our American friends while they are in London and I certainly think that not only those who are able to make the journey will derive great advantage from the Congress and plant exhibition themselves, but those who must remain at home will find much of interest in your reports of these meetings and discussions.



By **RT. HON. LORD MELCHETT**

*Director of Imperial Chemical Industries,
and Son of its Founder, the late Sir
Alfred Mond, First Lord Melchett*

CHEMICAL ENGINEERING'S rise to the status of a profession is probably one of the most significant developments in post-war industry in Great Britain. Prior to 1914 British chemical manufacture, apart from one or two notable exceptions such as the Solvay works and the Nobel organization, was carried on in what would now be considered small works, with plant of the same relative dimensions, and chemical engineering as known and appreciated today can scarcely be said to have existed.

The processes of chemical manufacture were carried out almost entirely under the immediate supervision of works engineers who had more or less "grown up in the business" and whose methods were largely rule-of-thumb.

Nothing else could be expected. The chemical industry was not scientifically developed; like Topsy, it "just grewed," and chemical engineering was an unrecognized part of such arts as salt-making, soap-boiling, sugar manufacture and the like, which had been carried on for centuries and which were founded on empirical methods based on experience garnered through the years. For instance, it is on record that in one works producing a crystalline product, the foreman, when wishing to produce a crystal of a certain size, added a cake of soap to the crystallizing tank, and to get another size, he threw in a cake of glue. No one at all knew the reason, nor when these practices started.

However, the chemical industry, so far as it went, was comparatively prosperous under these somewhat unscientific methods and this success undoubtedly led to a neglect, rather than to study, of the means by which the industry could become of the highest value to the country. In particular were the scientific principles underlying the design and operation of plant disregarded. The position was worsened to some extent by the fiscal policy of the country and certainly by the abuse of the British patent laws, whereby chemicals were imported from abroad instead of being manufactured at home, which had been the intended effect of those laws. Such, more or less, were the pre-war conditions.

With the outbreak of hostilities, immense calls were made on the chemical industry, to which it had great difficulty in making an adequate response. The war entirely altered the scale of British chemical manufacture. It had to expand, almost overnight, to a colossal degree, and its resources in plant, material and—possibly the most important of all—labor were strained to the uttermost. To assist this ex-

pansion chemists and mechanical engineers were called in for the design and operation of the vastly increased plants which had to be set up for the enormous output required by the specially created Ministry of Munitions. Though these recruits to the industry were experts in their own lines and undoubtedly "did their damndest," they were overborne by their lack of experience in the technique required. They simply had not the essential qualifications for the job.

The industry, however, was not found wanting, in spite of the difficulties of the times. The success which was achieved must be attributed in no small measure to the genius and immense driving power of an American citizen. Mr. Kenneth B. Quinan, for whose ability, energy and vocabulary his British colleagues have the greatest admiration, came to England from South Africa to take up the position of Technical Adviser to the late Lord Moulton, who was at that time the Director-General of Explosives Supply at the Ministry of Munitions.

The demand for explosives and chemicals of all kinds on an unprecedented scale demonstrated to the full the need for men scientifically trained in the translation of laboratory results into full-scale production. There had been some realization of this need as early as 1880, when an attempt to form a Society of Chemical Engineering had failed, but from which, in 1881, grew the Society of Chemical Industry, the

Jubilee of which was celebrated a few years ago.

There was, however, a voice crying in the wilderness—the voice of one who, like Rachel, would not be comforted. The late Professor J. W. Hinchley had realized the need for the trained chemical engineer and had long urged that such training should be made available. In 1909, long after chemical engineering had been a graduate course of study in American colleges, he was invited to lecture on the subject at the Battersea Polytechnic, London. The success of these classes led, later, to his being invited to lecture on two days a week at the Imperial College of Science and Technology, South Kensington, and, in 1917, to his appointment as Assistant Professor of Chemical Engineering at that College, being raised to the full status of Professor in 1926.

At the end of the war, before the reaction from the strain should have erased from men's minds the lessons of the preceding four years, he called together a number of leaders in the industry with a view to the formation of a professional organization for chemical engineers. It appeared, however, that the time was not yet ripe for this definite step to be taken. The necessary whole-hearted support was not forthcoming, but the Chemical Engineering Group was formed within the Society of Chemical Industry, with Professor Hinchley as Chairman and Mr. Harold Talbot as Honorary Secretary. The Group, now completing its



By Dr. HERBERT LEVINSTEIN, M.Sc., F.I.C.

President of the Institution of Chemical Engineers, past president of the Society of Chemical Industry, British Association of Chemists, Society of Dyers and Colorists

CHEMICAL ENGINEERING'S RISE TO PROFESSIONAL STATUS

seventeenth year of a vigorous life, has fulfilled a very useful function in consistently bringing before the chemical world papers in which various aspects of chemical engineering and its industrial applications were discussed.

It was not long, however, before it became apparent that, notwithstanding the excellent work of the Chemical Engineering Group, an independent professional body was required for the needs of this "new" branch of engineering practice. The enthusiasts who were primarily responsible for the creation of the Group again set their hands to the task and, at the end of 1922, the Institution of Chemical Engineers was formally incorporated.

The importance attached to the new venture can be gaged from the fact that the first occupant of the Presidential Chair was the late Sir Arthur Duckham, an engineer justly celebrated in the gas industry, who had held a number of important positions at the Ministry of Munitions and had been Director-General of Aircraft Production, a member of the Air Council and Chairman of the Cabinet Priority Committee. The Vice-Presidents were Mr. K. B. Quinan, who had returned to South Africa, and Dr. Charles Carpenter, the Governor of the South Metropolitan Gas Co., while Professor Hinchley held the onerous post of Honorary Secretary. It was during the last month of Sir Arthur Duckham's term as President that the first visit to England was made by the American Institute of Chemical Engineers. He was succeeded as President by the late Colonel Sir Frederic Nathan, who had also been prominent at the Ministry of Munitions and who was later closely associated with the work of the Fuel Research Board of the Department of Scientific and Industrial Research. He, in turn, was succeeded by Sir Alexander Gibb, who had been in charge of port construction for the British Armies in France and who, later, was Engineer-in-Chief at the Admiralty, and during whose term of office the Institution of Chemical Engineers was so hospitably entertained in the United States by the American Institute. It will thus be seen that the recognition of chemical engineering emerged as one of the results of the great European war and is one of the few good things arising from that catastrophe.

It was obvious from the outset that one of the first matters to which the new Institution would have to devote its attention was the question of the education and training of the chemical engineer. At the time of its formation the only classes available were the post-graduate course at the Imperial College, under Professor Hinchley, and the evening classes at the Battersea Polytechnic, then directed by Mr. Hugh

Griffiths. In 1923, however, the Ramsay Memorial Laboratory of Chemical Engineering was established at University College, London, with Professor E. C. Williams as first Ramsay Professor, this being another post-graduate course, and a similar course was inaugurated at King's College, London, in 1928, under Mr. H. W. Cremer. There have also been developments in Birmingham and in South Wales, and undergraduate courses have been started at Glasgow and Manchester.

The Institution immediately formed a strong Education Committee, under the chairmanship of Mr. C. S. Garland, and a preliminary memorandum on the training of a chemical engineer was drawn up, to which was added an "Outline of Subjects Special to the Training of a Chemical Engineer." This was submitted for comment to industrial leaders and firms throughout the country, where it aroused the greatest interest. Comments, both approving and critical, were received from all quarters over many months and, in the light of the views expressed, the Council, on the advice of the Education Committee, published in September, 1925, "The Training of a Chemical Engineer" which, though the time is now opportune for a reconsideration of its contents as a result of the experience gained over the last ten years, remains for the present the official document of the Institution on the subject and forms the basis for the examination, held annually since 1926, for admission to the Asso-

ciate-Membership of the Institution. It was also intended to serve as a guide to universities and technical colleges in arranging courses and examinations in chemical engineering.

This memorandum was widely circulated to universities and other teaching institutions and there is no doubt that it has been of considerable value to them and that, with the amendments which will most certainly be made, it will prove of still greater utility. Despite the careful thought devoted to the preparation of this document, however, and despite the fact that many firms concerned with the chemical and allied industries of the country were consulted before its publication, it cannot be truthfully said that even now the real significance of chemical engineering as an educational subject is universally recognized.

It is hoped that the brief outline given above is sufficient to apprise the readers of *Chemical & Metallurgical Engineering* of, and to interest them in, chemical engineering's position in Great Britain. Though the present state of affairs is far from the ideal, nothing is here for tears—in fact rather is it a matter for congratulation that so much has been accomplished in an essentially conservative country. To instance but one example of the progress made, the Institution at the end of its thirteenth year numbered well over 800 members, including in its number the leaders of the profession of chemical engineering, and is steadily growing, not only in numbers but in influence and prestige.

British Empire Largest User Of American Chemicals

Data for American foreign trade in chemicals and allied products, which are shown graphically on page 232 of this

issue of *Chem. & Met.* reveal the major importance of the British Empire as a customer for American products. Our exports to British possessions in 1934 totaled \$42,900,000 as compared with imports valued at \$13,500,000.

United States Exports of Chemicals and Allied Products to Leading Countries of Destination in 1934

1. Canada.....	\$20,900,000	12. British India.....	\$3,100,000
2. United Kingdom.....	17,100,000	13. Cuba.....	3,100,000
3. France.....	8,400,000	14. Belgium.....	2,700,000
4. Germany.....	7,000,000	15. Brazil.....	2,500,000
5. Japan.....	6,200,000	16. Sweden.....	2,100,000
6. Netherlands.....	5,100,000	17. Italy.....	2,100,000
7. Mexico.....	4,500,000	18. Union South Africa.....	1,900,000
8. Argentina.....	3,700,000	19. Colombia.....	1,800,000
9. Philippines.....	3,600,000	20. Spain.....	1,700,000
10. Australia.....	3,500,000	21. Hong Kong.....	1,600,000
11. China.....	3,300,000	22. Netherland India.....	1,200,000

United States Imports From Leading Countries of Origin in 1934

1. Germany.....	\$17,800,000	12. Switzerland.....	\$3,200,000
2. Chile.....	8,700,000	13. Brazil.....	1,900,000
3. Canada.....	8,100,000	14. Netherland India.....	1,600,000
4. Japan.....	7,000,000	15. Italy.....	1,200,000
5. Netherlands.....	6,700,000	16. Norway.....	1,400,000
6. China.....	6,600,000	17. Argentina.....	1,100,000
7. France.....	5,600,000	18. Hong Kong.....	1,000,000
8. United Kingdom.....	4,800,000	19. Mexico.....	900,000
9. British India.....	3,800,000	20. Soviet Russia.....	800,000
10. Belgium.....	3,500,000	21. British Malaya.....	600,000
11. Spain.....	3,500,000	22. Turkey.....	500,000

Total United States Exports to all countries including Alaska, Hawaii, and Puerto Rico, \$132,600,000; and total imports \$96,500,000.
Source: Compiled by Chemical Division of U. S. Bureau of Foreign and Domestic Commerce from "Commerce and Navigation of the United States."

By HERBERT WILLIAM CREMER

Joint Honorary Secretary of the Institution of Chemical Engineers and Director of Chemical Engineering Studies at King's College, London



QUALIFYING AS A CHEMICAL ENGINEER IN GREAT BRITAIN

IT CANNOT BE SAID that the present position in regard to chemical engineering education in Great Britain is a very strong one, and it certainly compares very unfavorably with that of the older branches of engineering, with the development of which, however, it offers little parallel. Mechanical and electrical engineering, together with civil engineering, in which the two first-named were originally included, have long formed an integral part of the curricula of our universities and technical colleges, but the teaching of chemical engineering is still restricted to some ten educational institutions throughout the country.

This tardy recognition of chemical engineering as an educational subject is all the more surprising when it is realized that as far back as 1887 the late George E. Davis, whose name was so closely associated with the "*Chemical Trade Journal*," of which he was founder and proprietor, delivered a course of lectures at the Manchester Technical School. In these lectures the view was clearly expressed that chemical engineering consists of a number of unit operations. It was left to the United States of America to inaugurate the systematic study of the fundamental principles of this subject, and educationalists in Great Britain owe much to the universities and the technical press of America for the extremely valuable contributions which they have made to chemical engineering literature.

The Council of the Institution of Chemical Engineers, as the body responsible for the professional standard of chemical engineers in Great Britain, favors an undergraduate course, starting from the matriculation stage, on the same lines as the courses for a Bachelor's Degree in the other branches of engineering already referred to. This procedure has indeed been adopted in one or two centres, but it is not general. The desirability for an undergraduate course has yet to receive general acceptance, and the lack of settled policy up to the present time has undoubtedly handicapped the development of chemical engineering education in this country. So many educational authorities do not yet understand the real significance of the subject termed "Chemical Engineering," and the view is still far too prevalent that a chemical engineer is a hybrid growth which can be produced by taking a ready-made chemist and giving him a year's top-dressing of engineering. As a consequence, some of the schools of chemical engineering of long-standing have been developed in the form of post-graduate courses in the Faculty of Science, under the aegis of departments of Pure or Applied Chemistry, although there are cases in which

such schools are represented by separate Departments of Chemical Engineering.

Chemists who have been largely responsible for determining the policy to be adopted in educating the chemical engineer have been loath to accept the view that chemical engineering is suitable to be treated as an undergraduate subject. The writer has heard it stated with some emphasis that the research chemist is the originator of the big ideas in the chemical industry and that a person who receives an undergraduate training in chemical engineering would not be capable of such original thought. In other words, there is a tendency to overlook the point that industry has need of both the research chemist and the chemical engineer.

There are signs, however, that chemical engineering may, at no distant date, come to be regarded as suitable to be included, not in the Faculty of Science, but in the Faculty of Engineering, alongside civil, mechanical and electrical engineering which, to many in this country, appears to be its rightful place. It is realized, of course, that chemistry, as such, will call for specialized treatment and will necessarily form a far larger part of the curriculum than in other branches of engineering.

Meanwhile, the number of teaching institutions in which a Bachelor's Degree in Chemical Engineering can be gained is relatively small, and the usual hall-mark of the chemical engineer consists of membership or associate-membership of the Institution of Chemical Engineers. The Institution recognizes four grades of membership, viz. members, associate-members, graduates and students. Persons in the first two classes are known as corporate members, and possess full voting powers in general meeting in con-

nection with the management of the Institution. Some information on these various grades of membership may be of interest.

The class of students is a form of registration with the Institution signifying that the person concerned proposes to enter the profession. This he does either (a) by entering on an appropriate course at one or other of the colleges teaching the subject, or (b) if already in industry, by acquiring practical experience in his employment, supplemented by part-time study. No one can remain a student beyond the age of 26 years.

The class of graduates comprises young men who have spent some years in industry and have a rudimentary knowledge of the profession gained from their employment, or who have attained a certain standing in chemical engineering at college by research in the subject.

The class of associate-members is probably the hardest one for a candidate to enter. Here we find men who have definitely started to make their way in the profession. Admission is gained in three ways:—(a) direct election because of the applicant's status in the industry; (b) by having passed one or other of the college examinations which the Council accepts in lieu of the Institution's own examination; and (c) by passing the associate-membership examination of the Institution. In cases (b) and (c) the examination success must be supported by practical experience in chemical engineering which the Council deems sufficient over a period of not less than two years.

The final class, that of members, is filled direct from applicants whose status in the profession is such as to warrant their election without further scrutiny.



A general view of the Billingham factory of Imperial Chemical Industries, Ltd. before the construction of the coal hydrogenation plant

Great Britain Produces Chemicals For World Consumption

By J. DAVIDSON PRATT, O.B.E., M.A., B.Sc., F.I.C.

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GREAT BRITAIN is essentially an industrial nation and must sell her products in the markets of the world in order to buy raw materials and foodstuffs necessary for her existence. A comprehensive and progressive chemical industry is therefore vital to her existence, and this she now possesses, thanks to the progress of the last 20 years.

Great Britain may justly claim to be the country richest in three important basic substances: namely, coal, salt and limestone. Historically, the materials made with these began her vast heavy chemical industry. Coal, the great provider of heat and power, salt, limestone and imported sulphur, enabled Great Britain to be the first to manufacture sulphuric acid some 200 years ago, and chloride of lime about 150 years ago. These substances gave her great textile factories and those of the world at large a great impetus for expansion. Since those early days, the production, scope and number of heavy chemicals have increased enormously, and Great Britain has utilized the raw materials of the whole world in this work.

The heavy chemical branch of the industry has been subjected in the last ten years to the modern process of scientific reorganization, and this has led to improved efficiency by the concentration and modernization of plant, and to an intensive development not only in regard to the production and use of new products, but also in connection with the application of old materials to novel purposes. Among the recent developments might be mentioned the manufacture of synthetic hydrochloric acid from the by-product hydrogen and chlorine of the alkali industry; the oxidation of ammonia to nitric acid, thus obviating the need to import Chili nitrate; the production of a new white pigment in titanium oxide; di- and tri-sodium phosphates as detergents; sodium metaphosphate for the treatment of boiler water; chloronaphthalene synthetic waxes with flame-resisting properties; the employment of sodium aluminate as a coagulant; the use of ammonia with chlorine for water sterilization; the lime-soda process of softening and conditioning industrial waters; the use of sulphuric acid for weed killing; the re-

fining and desulphurizing of metals by sodium carbonate and the molten cyanide method for case hardening steel. At the moment many new developments are in progress and these include the production of materials of national importance such as magnesium, potassium permanganate, sodium chlorate and calcium carbide.

Included under the description of agricultural chemicals are fertilizers, insecticides and fungicides of all kinds. A new source of potash, the Dead Sea in Palestine, a British mandated territory, is now being actively developed, and will also produce an important byproduct, bromine, for which Great Britain has previously been dependent on foreign sources. Superphosphate owed its origin to the pioneering research work carried out in Great Britain in the middle of the last century. The capacity of the existing plants is more than adequate to meet all the present and prospective requirements of British agriculture. Modernization of equipment is taking place and a new factory utilizing byproduct sulphuric acid from the zinc industry, is now coming into production. An ex-

tended development of the export trade is contemplated. The raw material, phosphate rock, comes from North Africa, Florida or the Pacific Islands.

The post-War years have seen a revolutionary change in the supply of nitrogenous fertilizers. Previously Great Britain was dependent on Chili nitrate, though she produced a small amount of ammonium sulphate as a byproduct from gas works. Following on the example set by Germany, the British industry has elaborated a new technique for carrying out reactions at high pressures and temperatures, and has established the production of synthetic ammonia on a scale which makes overseas supplies of nitrogenous fertilizers entirely unnecessary. This represents a remarkable feat of chemical engineering. The experience gained has made possible the synthetic production of methyl alcohol and the hydrogenation of coal, and has opened a wide avenue for future developments.

Much work has also been done on the production and use of composite fertilizers which should effect considerable economies in transport in addition to possessing special fertilizing value. Extensive schemes of research and propaganda are in operation in order to determine how the available fertilizers can be used to best advantage, and to put this knowledge at the disposal of the farmer. This is a typical example of the way in which the British chemical industry studies the requirements of the consumer and is continually assisting

him, either in regard to providing improved methods for using old products, or new materials of superior efficiency.

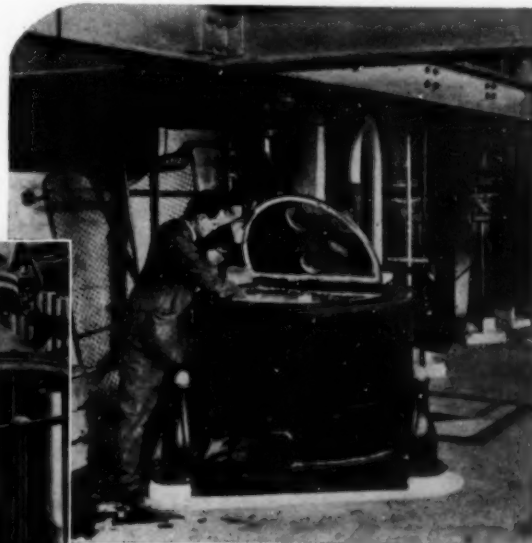
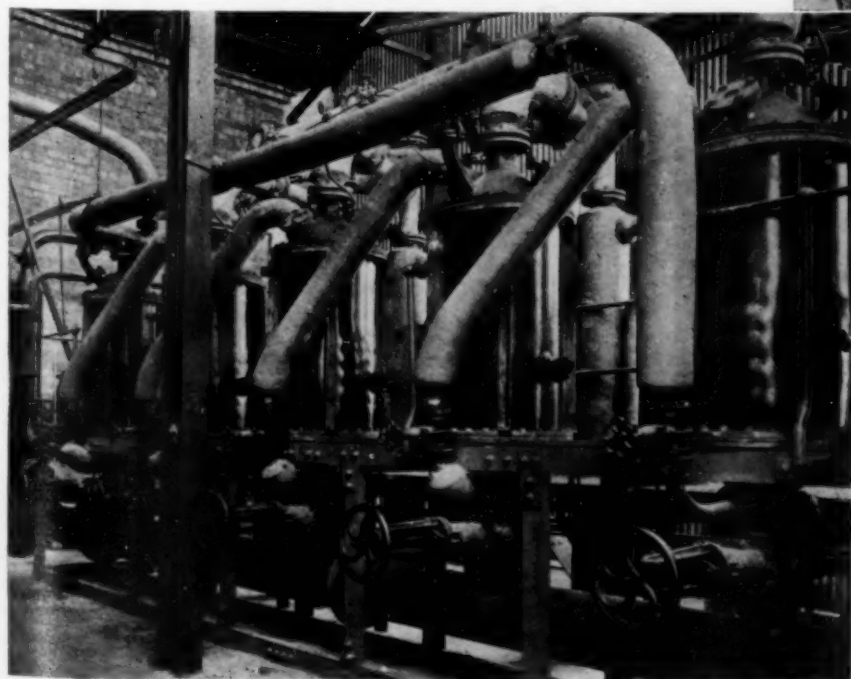
One of the most important problems of agriculture the world over is the control of insect, fungus and animal pests. To solve it, British industry provides a variety of materials. Among the newer preparations are those derived from pyrethrum and derris which have a special advantage in that they are non-toxic to warm blooded animals. Developments have also taken place as regards the production and use of liquid hydrocyanic acid as a general fumigant, and of ortho and para dichlorobenzene and sodium cyanide as soil fumigants.

Great Britain was the first to enter the field of coal distillation. In 1825, the famous British chemist, Faraday, discovered benzene and this set on foot in the years that followed a great search for the means of separating coal tar into its constituents. The outcome of these investigations was to convert what had been originally a sticky, smelly, tarry byproduct of no commercial utility into a valuable raw material, on which a range of new and highly important industries have been based. As everyone knows, the constituents of coal tar, such as benzol, toluol, naph-

thalene, anthracene, creosote oil, carbolic acid and cresols form the basis of the dyestuffs, explosives, disinfectants, pharmaceutical and synthetic resin industries, while refined tar paves the highways of the world. The economic importance of certain of these raw materials has been so great that supplies from coal tar have become inadequate and as in the case of phenol, factories for their synthetic production have been brought into operation. The British coal tar industry originally consisted of a large number of units, many of them small, all over the country. The last few years have seen the consolidation of these units into a few big groups on an area basis. This, together with the setting up of marketing organizations for benzol, creosote and pitch, has greatly strengthened the industry to the national advantage.

One of the most important problems in recent years has been to discover methods for the better utilization of the national coal resources. The new developments have followed two main lines, namely low temperature carbonization and hydrogenation. The former, after passing through many vicissitudes, has now become firmly established; in addition to producing a

Below—Catalyst furnaces at the acetaldehyde plant of the Hull works, British Industrial Solvents, Ltd. Right—One stage in the production of phenolphthalein at plant of the British Drug Houses, Ltd. Notice the centrifugal hydro-extractor



valuable smokeless fuel, the general use of which would banish forever the pea soup fogs for which London is notorious, it provides considerable quantities of both light and heavy fuel oils. The byproduct tar also opens up a new and important field of development; not only can it be hydrogenated easily to give liquid fuels, but it can be separated into a large number of constituent bodies, quite different from those in ordinary coal

tar. These bodies, which have been prepared and identified by a remarkable piece of research at the chemical research laboratory of the Department of Scientific and Industrial Research at Teddington, may well prove the basis for a range of new industries as did the products of coal tar in the past.

Great Britain has been responsible for the first real oil fuel production from ordinary coal by hydrogenation. Though based on the German Bergius process, the painstaking work of the last 10 years has resulted in remarkable advances, the outcome of which is seen in the large scale unit which commenced production at Billingham last year. The plant can produce either light or heavy fuel oils as desired; it has a capacity of approximately 60,000,000 gal. per annum and can use either creosote or coal. As a byproduct of the hydrogenation, butane is obtained and the use of this, when compressed into cylinders, is being developed for domestic and cooking appliances in areas which are devoid of gas works.

The British wood distillation industry has been slowly dying since the War. Originally it had to compete with wood distillers in countries better provided with the necessary raw materials, but the most serious blow was struck a few years ago by the synthetic production of the byproducts on which it mainly depended, namely methyl alcohol, acetic acid and acetone, of which wood distillation was until then the main source of supply. These three outstanding developments have rendered Great Britain independent of overseas supplies of these basic chemicals. There are two processes in operation for acetic acid, one using alcohol as the raw material and the other calcium carbide. The forthcoming manufacture of carbide in Scotland will assure adequate home supplies of all the raw materials for these processes.

Prior to the War, the British fine chemical industry was of restricted scope and was sadly lacking on the organic side. The War experience showed that fine chemicals were vital to the national existence and that their manufacture was in fact a key industry. Thanks to the protection and the stimu-

lus afforded by the Key Industry Duties imposed by the Safeguarding of Industries Act in 1921, the British fine chemical industry has made great progress and can rightly be regarded as one of the most important in the world. The British industry makes over 4,000 different fine chemicals which fall into the following classes: medicinal and pharmaceutical products of all kinds; photographic chemicals; laboratory chemicals; perfumery chemicals and essential oils; rare earths; and last but by no means least in magnitude, solvents and plasticizers of a wide variety of types for the perfumery, soap, lacquer and varnish trades.

LIKE the organic side of the fine chemical industry, the British dyestuffs industry was of insignificant dimensions prior to the War, in spite of the fact that the industry really originated in Great Britain in the latter half of the last century. Germany practically controlled the production of the world. The grave difficulties experienced by the textile trades in consequence of the cessation of their principal source of supply on the outbreak of War in 1914 were responsible for the great efforts that have since been made to develop the British industry so that the British dye consuming interests might never again be at the mercy of a foreign power. Protection has been afforded to the industry by the Dyestuffs (Import Regulation) Act first passed in 1920, which prohibited the importation of synthetic dyestuffs, coloring matters and intermediates except under license. In spite of the fact that the British industry had to make up the leeway of 50 years, the results have been remarkable, and have been achieved without detriment to the dye users. In 1913, less than 20 per cent of its dye requirements were produced in Great Britain, and most of these were made from imported intermediates. Now over 90 per cent by weight are supplied from home sources, which also provide practically all the intermediates. At the same time an increasing export trade has been built up in the face of intense foreign competition. The British indus-

try now offers a more extensive range of colors than any country except Germany and Switzerland. The imports are essentially what might be called novelty products of the luxury type. Quality and price are on a par with those obtained abroad.

Research work, the real basis of any dye industry, has been incessantly maintained as is proved by the fact that Great Britain in the post-War years has been responsible for more of the really important new dye discoveries than any other country.

The latest development is the recent production of a new pigment called Monastral Fast Blue B.S. Its discovery reads like a romance. It arose from the scientific investigation of an undesirable impurity. It is the only blue pigment discovered in the last 100 years. It has excellent tinctorial strength and beauty. It has certain properties of fastness to all agencies which give it a pronounced advantage over the two old standard blue pigments, namely prussian blue and ultramarine. These advantages more than outweigh its present high cost and it offers great possibilities for paints, varnishes, distempers, printing inks, textiles, plastics and rubber.

No dye industry can be really sound unless it can depend on home produced intermediates. Here again the British industry has made remarkable progress and is practically self-sufficient. It has also made a large number of new products and processes for dyeing and finishing, among which might be mentioned the recent discovery of a new method of wool dyeing. This method enables the fiber to be brought into closer contact with the dye; absorption is more rapid and the dyeing can be done at a much lower temperature. Great progress has also been made in the study of allied organic compounds such as rubber accelerators and anti-oxidants, the use of which shows prospects of extensive development.

AS regards organization, the chemical industry has taken the lead in the application of the principles of scientific organization, and has made great progress in this direction. It has a strong trade organization, the Association of British Chemical Manufacturers, which acts as its mouth-piece on all questions of broad policy, and is regarded by the Government as the authoritative body for the submission of the views of the industry. To this body are affiliated a number of other associations dealing with specialized aspects of the industry. Space prevents a detailed account of the work of the Association but briefly it may be said that, outside the labor field, it deals with all problems which can best be solved by co-operation and a united front.

New Beeston Works of Boots Pure Drug Co. Ltd. at Nottingham, England



Depression Proved a Boon to Chemical Plant Makers

By J. ARTHUR REAVELL

*Kestner Evaporator & Engineering Co., Ltd.
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LIKE THE REST of the world in recent years Great Britain has been through a financial crisis more severe than any in our history, not excluding the "hungry forties." The allusion to the "Great Depression" is necessary because chemical engineering in this country cannot be discussed without reference to the economic situation. Its present position is paradoxically due to the exactions and opportunities of the times, and these same causes will fertilize its growth in the coming years, given the favorable international atmosphere essential to any island plant.

When in 1931 we took the financial steps that then seemed essential to our recovery from the slump into which we had been precipitated by American and mid-European disasters, we took them in what has been called the "bull dog" spirit. We were determined to pull ourselves out of our troubles and readily tightened our belts to do so. We could not reconcile ourselves to seeing our economic and industrial history of the last two hundred years thrown away; nor to seeing our standard of living crumble, without an effort to hold it together. I need not describe the latest wonder of the world: how "decadent" Britain has not only held her own, but stepped into the van of recovery. Far from falling from our standards, we seem to have increased them. We feel there is life in the old dog yet.

The Great Depression naturally halted all industrial expansion; and with it curtailed many programs of technical research. But not all. The financial steps we took in 1931 turned us from a free trade country into one more like the American, where industry shelters behind tariff walls. These were the exactions and opportunities of the times to which I ascribe much of the advance we have made in chemical engineering of the last two or three years. Research was continued, on a restricted scale perhaps, but with greater determination. Tariffs fostered internal recovery. Internal recovery made new demands. Once internal recovery had advanced far enough to encourage industrial investment, inven-

tion found its age-old opportunity in modernizing old industries and establishing new. We started to feel the slump towards the end of 1929 and reached the trough in July, 1932; today the state of trade is more flourishing than it was in the former year, and that means more flourishing than it has ever been in our history.

The capital equipment industries of which chemical engineering must today be regarded as, if not the chief, certainly most important, have led the way. At the time of writing, the end of March, 1936, nearly four years after we commenced our upward swing, those industries still lead. More than that, they show every sign of continued expansion. The demand for iron and steel materials continues to enlarge. In fact, the demand is such that deliveries fall into arrears and the chemical plant maker finds the utmost difficulty in keeping time on his contracts. More than one of the leading houses has been working round the clock for the past two years, and it is said that today there are more orders on the books than ever there were.

So far as chemical plant is concerned our newly built tariffs have operated in two ways. They have encouraged our manufacture of previously imported chemicals. For these we have, where necessary, imported the requisite plant under a licensing system that allows it in tariff free. Wherever it has been possible to utilize home-built plant this has been done. Both have encouraged the British plant maker. What may be termed his "bread and butter" work has been protected and with his "overheads" thus assured, he has turned his natural inventiveness to more specialized chemical engineering, which in turn has qualified for protection. So far as highly technical industry is concerned our tariff system has provided excellent "snowballing" conditions. And please remember that we are but beginners in the gentle art of tariff making.

Mention of a few recently completed contracts will, perhaps, exemplify my thesis. In October last Mr. Ramsay Macdonald officially opened the I.C.I. plant in Durham for the hydrogenation

of bituminous coal. A plant in which that firm has invested some five million sterling. Earlier in the year National Coke and Oil successfully started up near Birmingham the first of five low temperature plants for the winning of motor spirit and diesel oil from coal. Coal and Allied Industries are erecting a plant near Billingham for a similar purpose, whilst Low Temperature Carbonization, Ltd., are increasing their capacity. These I quote to illustrate our determination to apply chemical engineering to the exploitation of our greatest national asset—coal. Our coal-fields gave us the opportunity to initiate the "Industrial Revolution" of the late eighteenth and early nineteenth centuries. Our new endeavors to exploit them may well lead to another that in days to come will be named the "Chemical Engineering Revolution." Agriculture too has felt the benefit of protection and, again, fertilizers have provided another opportunity. One large plant was recently completed on the East Coast and a similar one is nearing completion in the West. Milk and other foodstuffs are finding employment for some of the best of our chemical engineering skill, thanks to the activities of the marketing boards set up as part of our recovery plans. Pharmaceutical and allied manufacture has encouraged invention, and cod liver and halibut liver oil plants have been erected of first class technical importance.

I could go on to many other examples, but detail would soon run away with the space at my disposal. Mention must be made, however, of materials and their utilization. Metals and their alloys have improved out of all recognition. Much attention has been necessarily paid to protective coatings and non-metallic materials of construction. We have made great advances in lining plant with glass, rubber, enamel, lead, silver and stainless steel, to mention a few, while considerable advances have been made in chemical stoneware by the leading British makers.

This grasping of the opportunities in the home market has been most encouragingly accompanied by expansion overseas. Chemical engineering, for the first time perhaps in Britain's history, has become an exporting industry of importance; and here, curiously enough, we do not seem to have confined ourselves to the openings provided by the industrialized areas of the Empire, although naturally they have not been neglected. Of late years British plant has been purchased on an increasing scale in the Near and Far East, and South America; some indeed has found its way to the United States. Most of these contracts abroad demand spe-

cial care in that the conditions of their service impose a robustness of construction uncalled for in plant installed in highly industrialized localities.

So much for the immediate past. Materially speaking, the future is not without its attractions. I have already referred to the fullness of our order books. But man, and certainly the chemical engineer, cannot live by bread alone. The enforced inactivity of the Great Depression was not wholly bad. We had time to take technical stock of ourselves, and, I think, not without profit. I doubt whether even those in closest touch with the research that went on appreciated how readily it would bear fruit once conditions ameliorated. To the outsider it undoubtedly came as a revelation. The change in economic circumstance in the last four years has served to focus our work. What might then have been regarded as academic speculation is now showing up on the screen in well accentuated high lights and shadows. Whether we need to develop those shadows more fully time alone will show.

To maintain the metaphor, it seems, at the moment, that the screen shows most strongly the attention we have paid to heat transfer and distillation. These are fundamental problems we have naturally had to investigate in connection with the high pressure and other work involved in the exploitation of our coal resources. In these subjects industrial workers, particularly those in the employ of the I. C. I., and Distillers Co., Ltd., have augmented and collaborated in the work emanating from academic and government sources. The numerous establishments under the aegis of the Department of Scientific and Industrial Research have contributed much of the utmost importance. One could wish that industrial concerns would publish as readily as do the D. S. I. R.

Filtration is another subject to which considerable attention has been devoted. The numerous problems associated with drying, with the cleaning of gases, the recovery of solvents and crushing and grinding have received their full share of investigation, to mention but a few of the topics that have formed the subject matter of papers read recently before the various learned bodies.

I have mentioned academic workers. I wonder how many people outside this country realize the extent and quality of the schools of chemical engineering and industrial chemistry we possess. We have more per head of the population than any country in Europe. In London alone there are three; Glasgow possesses another in the chemical engineering department of its School of Technology. The Manchester

School is well known and at Liverpool Professor Hilditch is building traditions, second to none. All of these are well equipped with plant provided by the generosity—and may I say, forethought—of plant manufacturers, who maintain the closest of liaisons with both staff and post-graduate workers. The latter, they wisely realize, are the new blood needed not only by the chemical and allied industries, but also by themselves, the suppliers of plant and equipment for the companies in those industries.

We are beginning to appreciate, I think, that the Great Depression did us good. It gave us a breathing space, unwanted, it is true, but profitable all the same. The tariffs we unwillingly imposed started an industrial renaissance wherein we were able to apply our accumulated technical knowledge. They created a home demand for equipment, and so on, that has fostered an increase of that knowledge to the benefit, first of all to ourselves, but ultimately, I feel sure, to the rest of the industrialized world.

Much Progress to Be Evident at Chemical Plant Exhibition

By LORD MELCHETT

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AS A PRACTICAL industrialist, one of my foremost interests at the time of the Chemical Engineering Congress will be the exhibition of chemical plant which is to be held simultaneously with the Congress in the Central Hall, Westminster. Only two such exhibitions have previously been held in Great Britain, one in 1926 and the other in 1931. This year's exhibition is being arranged by the British Chemical Plant Manufacturers' Association, and, although the Congress itself will be international in character, the Exhibition will be confined to British plant. As this is written it is impossible to give exact details of the various exhibits, but it may be of interest to note that progress since 1931 in chemical engineering has been so rapid that a very large proportion of the plant on exhibition will be absolutely new in character.

Before dealing with some of the principal directions in which advance has taken place, it is worth while mentioning that the chemical engineering industry in Great Britain is at the present moment having an exceptionally successful period. So great is the pressure of work that no one will undertake delivery even of the simplest items in less than six weeks. This is not merely due to home demand owing to domestic industrial recovery: it is also accounted for by the increased pace of exports to other countries. We are still importing a good deal more of highly elaborate equipment than we export, but the gross average value of our exports is rapidly increasing, having risen from £67 per ton in 1933 to £82 in 1934 and £87 per ton in 1935.

Chemical engineering proper begins and ends, of course, with the manufacture of plant, and if we wish to appreciate the principal trends of advance in chemical engineering we must bear in mind the demands of modern industrial processes for abnormally high pressures and temperatures and high vacua. It follows that most of the latest developments in chemical engineering have been in respect of new materials or in established materials worked in different ways. The principal interest of the Exhibition, therefore, will probably be in the many items of plant and equipment made in these new or improved materials.

Since the last Exhibition, synthetic resins of the phenol-formaldehyde type have established themselves firmly as materials for plant construction. While it cannot be asserted that these plastic products have solved all the problems of corrosion, their uses are sufficiently numerous to have created an entirely new industry for the chemical engineer. The booth in which most of the recent developments in the use of synthetic resins will be exhibited is that of the Kestner Evaporator & Engineering Co., Ltd., which controls the marketing of the material known as "Keebush"; the product is actually manufactured by the Bushing Co., Ltd., of Hebburn-on-Tyne, which in its turn is controlled by Reyrolle and Co. and the General Electric Co., Ltd.

These resins are combined in the course of manufacture with backing materials of an acid-resisting character, so as to maintain the laminated formation which gives them their very high me-

mechanical strength coupled with resistance to many acids and alkalis. The materials can be machined as easily as metal, and pipes are constructed as a standard product in sizes from $\frac{1}{4}$ in. diameter up to 8 in. diameter. A 2-in. standard pipe of this kind can be used for hydrochloric acid at a temperature of 100 deg. C. and a pressure of 50 lb. per square inch without any danger. The material can be used for acid cocks and valves, fans, pumps and steam injectors. The material has also been used for the construction of vats in one piece up to a diameter of 6 ft. It is also resistant to dilute sulphuric and to the majority of organic acids, as well as dilute alkalis; and it has a notably low coefficient of expansion. Its present price lies somewhere between those of copper and of stainless steel.

Stainless acid-resisting steel itself is now available in every form required by plant manufacturers, and on the side of ferrous metals one of the most important exhibits will be that of Firth-Vickers of Sheffield.

Another development of importance in connection with modern high-pressure technique is the system of seamless welding of pressure vessels developed by the firm of Babcock & Wilcox. While on this subject it is worth while men-

tioning an interesting example of electrical welding which appeared during the year. This was a fractionating tower 60 ft. high and 53 tons in weight, installed in one piece by Herbert Greene of East Halton.

On the non-ferrous metals side, one of the most interesting stands should be that of the Aluminum Plant & Vessel Co., which manufactures a comprehensive range of chemical plant in aluminum, copper, gun metal and phosphor bronze. From the chemical engineer's point of view the most important attributes of materials used in plant construction are their mechanical properties, resistance to corrosion and weldability. This firm has greatly increased the range of uses for copper as a constructional material for processing plant, especially where resistance to pressure and to corrosion is required, by the development of a sound method of welding copper autogenously.

Also among the non-ferrous metals, Monel metal is now being successfully used instead of wood for pickling drums in the tanning industry.

Messrs. Johnston Matthey & Co. have recently put on the market a new copper-silver brazing alloy with additions of phosphorus, which is claimed to give exceptionally homogeneous jointing

with brass and copper, requiring no flux with the latter. This material is marketed under the name of "Sil-Fos."

The use of stoneware in chemical plant manufacture has been given a decided impetus by the fact that it is now possible to manufacture, out of English materials in England, the so-called "white" chemical stoneware, of a quality at least equal to that of the product previously imported from the Continent. The manufacturers, Messrs. Doulton & Co., of Lambeth, will be represented at the Exhibition. The smoother surface of this white stoneware has been shown to have a specially great advantage for the manufacture of chemical preparations, particularly pharmaceutical products, since the smoother surface has less effect on the crystallization of chemicals than the surface of ordinary acid-resisting stoneware. Not only has the vitrified stoneware body a completely leadless glaze, but it is, also, absolutely acid-resisting. This development in chemical stoneware manufacture follows on the solution of the important problem of producing from British raw materials a reliable stoneware body with a water absorption of nil.

There are various other interesting materials; in particular, from the constructional point of view, an asbestos wood supplied in sheet form under the name of "Turnall" and made by Turners Asbestos Co. Not only is this material fire-resisting but when hot it does not spit or explode when sprayed with cold water.

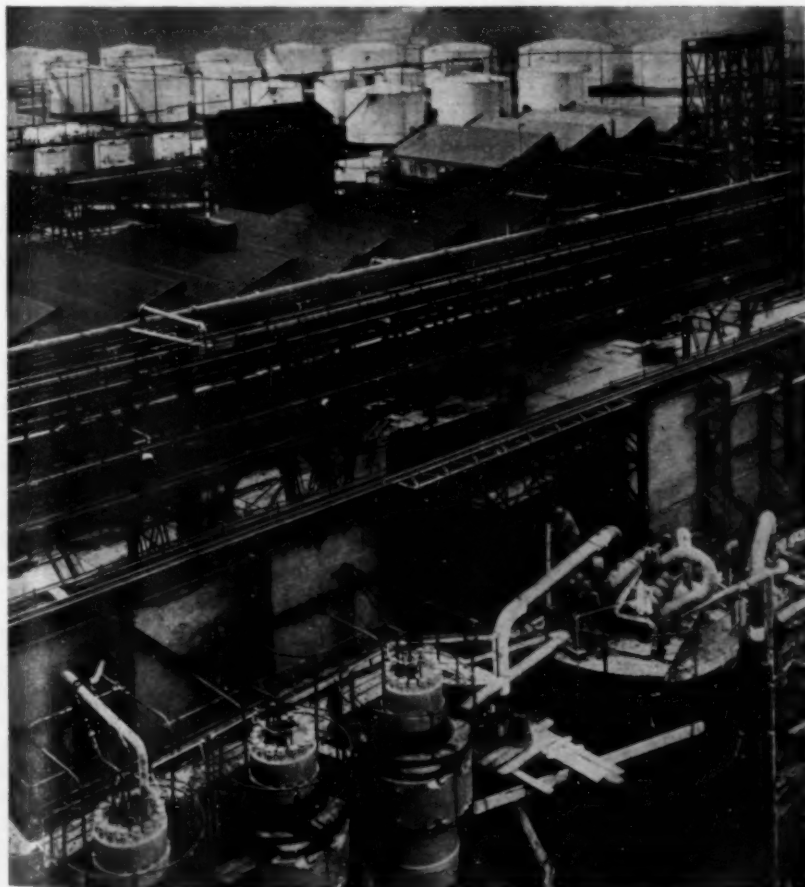
Raschig rings can now be obtained in carbon and give a large reduction in weight compared with the normal metal rings. A new protective coating which is not absorbed by a porous surface such as cement and is unaffected by lime has been introduced by Detel, Ltd., in a variety of grades under the name of "Detel."

Another interesting new material is a self-hardening acid-resisting cement, called, "Asplit," supplied by J. M. Steel & Co., which is resistant to HCl and H₂SO₄ (50 per cent), to organic acids, and to steam up to 350 deg. F., while a special powder is available for withstanding HF up to 50 per cent.

Finally, it is interesting to note that the Mermal Syndicate has recently shipped to Japan the first of a series of plants for the synthesis of HCl. This plant is made of pure fused silica.

In general, then, as I have said, the principal interest of the Exhibition is likely to be found in the use of these various materials which, in addition to the particular qualities which I have stressed, offer the chemical manufacturer robust products which he may use in place of the somewhat delicate materials for construction which have been available in the past.

Looking down on a conversion unit in the I.C.I. coal hydrogenation plant at Billingham-on-Tees, England



Germany

Forges Ahead With Many Industrial Developments That Reflect Changing Economic Conditions in Which Chemical Engineering and Industry Will Play a More Important Rôle



WHY CHEMICAL INDUSTRY IS INTERNATIONAL

By GEHEIMRAT PROF. DR. CARL BOSCH

*Chairman, I. G. Farbenindustrie A. G.
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WITHOUT EXAGGERATION, we may assert that no other industry essential to national life depends on international cooperation to such a high degree as the chemical industry. Every day new problems emerge—scientific as well as economic. These problems cannot be considered from a purely national point of view because they extend into the international sphere.

All countries with highly developed industries carry on chemical research on a large scale. We see, therefore, inventions originating not in one place only but in several. The history of science portrays numerous examples of important and entirely new ideas which have come to life almost simultaneously in two or more widely separated localities. Outstanding recent examples in this respect are the various processes for nitrogen fixation and synthetic rubber, the latter having been developed concurrently in Germany and the United States. Sometimes each inventor proceeds along entirely different lines from the other; then again, certain connections are apparent. In many cases, it would be of great interest to both inventors to be able to make comparative studies in order to improve each process.

Because science is interrelated to a very considerable extent, and because it is highly desirable to avoid costly and protracted patent litigation with its unpredictable results, mutual understanding on the part of all concerned is the obvious object to strive for. This con-

dition almost compels the various interests to conclude international agreements.

On the other hand, a willingness for collaboration on scientific grounds is of special significance to chemical industry on account of the economic import that all inventions ultimately exercise. Usually, outstanding new developments in chemistry create products that are not confined within national boundaries. On the contrary, such new products find markets not only within neighboring countries but all over the world unless tariffs or other trade restrictions provide insurmountable obstacles.

In most cases it is necessary to negotiate trade agreements to assure normal development and outlets for new products and to avoid far-reaching disturbances in trade, for every new product bears a close relationship—at least economically—to other existing products and shows a tendency to upset trade.

Owing to these conditions, the large European producers of chemicals entered into agreements at an early stage. It was necessary to coordinate continued independence and to guarantee expansion, as far as home markets were concerned, and the legitimate export interests of all participants. The results were most encouraging, notably in the field of coal-tar dyes and nitrogen; the great majority of the principal European manufacturers have joined in these conventions. Connections have also been established with

non-European producers with the exception of those in the United States, but no binding agreements have been concluded.

As for the United States, the anti-trust laws prohibit agreements such as those prevalent in Europe; but American producers have the advantage of still undeveloped markets and other favorable conditions. Therefore, cooperation with the principal American manufacturers is essentially limited to the scientific field.

As a sidelight on chemical engineering in Germany, it may interest American chemical engineers to learn that in this country we do not recognize the profession as do the United States and certain other countries. In general, we separate the functions into those of the chemists on the one hand, and of mechanical engineers on the other. But it is significant in the development of German chemical industries that both professions have collaborated intensively. Pure scientific chemical research, as practiced in the laboratories of our universities, is recognized by industry. In close collaboration with the chemist, engineers develop the technique for industrial applications of pure chemistry.

The claims on the inventive ability of chemist and engineer are constantly more exacting. The German chemical industry achieved its great success by continuous close cooperation between chemist and engineer, as is best illustrated by the development of the synthetic nitrogen and hydrogenation industries.

GERMANY'S leading position in the chemical industry prior to the World War is a matter of common knowledge. In 1913 its share in the world production of chemicals amounted to almost 25 per cent, while of the total world exports of chemicals more than 28 per cent was of German origin. The corresponding figures for 1934 as published in *Die Chemische Industrie*, January, 1936, are 16 per cent for production and 27 per cent for foreign trade of the world. When we consider the fact that in 1913 fully 32 per cent of the world's chemical production was involved in international trade, whereas by 1934 this proportion had dropped to only 12 per cent, it is evident that Germany has suffered a heavy loss through the building up of chemical industries in many countries. In spite of this, she is still maintaining her position in exports—with more than double those of any other nation.

During recent years the economic life of Germany has been deeply influenced by governmental regulations and the increasing shortage of foreign raw materials—both factors stimulating the development of substitutes and the utilization of waste materials. Chemical industry has benefited by these trends. In 1935 it had on its payrolls more than 400,000 employees of which at least 10,000 were qualified chemists. The volume of exports in 1935 increased by 13 per cent over those of 1934 and in addition there was a considerably higher domestic sale as indicated by an advance of 20 per cent in fuel consumption. Judged on the basis of man-hours of labor, production increased from 69.9 to 76.5 per cent of capacity. The best showing was made by the heavy chemical, explosives, paint materials and fertilizer industries while pharmaceutical and fine chemical industries increased their volume but decreased in value of output. Exports were stimulated by certain subsidies permitting lowered prices, but strict governmental control of the domestic market tended to depress profits and force the German chemical industry to absorb higher taxes and costs, such as increased freight rates.

Governmental regulation extends to prohibition of any increase in productive capacity in certain fields such as nitrogen, superphosphates, and lamp black. Trade practices have been standardized with the view to protecting the small and medium sized producer. On the other hand, industrial concentration is continuing both by vertical integration of subsidiaries and affiliates and by horizontal acquisition outside of the immediate field of the

"RESEARCH IS POWER"

In

German Chemical Industry

Editorial staff summary of current developments based primarily on official reports of United States Consul Sydney B. Redecker, Frankfurt-on-Main, with certain supplementary data supplied by the Chemical Division, Bureau of Foreign and Domestic Commerce, Dept. of Commerce

parent company. The Nobel group, for example, is consolidating its corporate structure; Kaliwerke-Salzdettfurt A.G. purchased a 30 per cent interest in Mansfield A.G. für Bergbau und Hüttenbetrieb, an important producer of copper, brass and light metals. Cartels and syndicates have made further progress, in some instances concluding international agreements such as the potash convention between producers in Germany, France, Spain and Palestine and the nitrogen pact extending over Europe, Chile and Japan.

Dependence on foreign raw materials for chemical industry is most pronounced in the case of vegetable oils, naval stores, crude botanical drugs, phosphates, borax, sulphur, pyrites, carbon black, petroleum and rubber. At

least 25 trade control boards regulating raw material imports have been set up by the government, one of which specializes in chemicals and chemical raw materials.

With the slogan "Research is Power," the German chemical industry has intensified its activities in the development of new products, particularly synthetic materials produced from domestic sources. Special efforts have been made in the synthetic production of textile fibers, rubber, resins, motor fuels, technical oils and waxes. Synthetic rubber is now produced in a pilot plant from butadiene and is marketed under the trade name "Buna." It was introduced to the public at the recent International Automobile Show in Berlin and is said to be superior to the

Polymerization equipment used in the manufacture of the German synthetic rubber, "Buna."

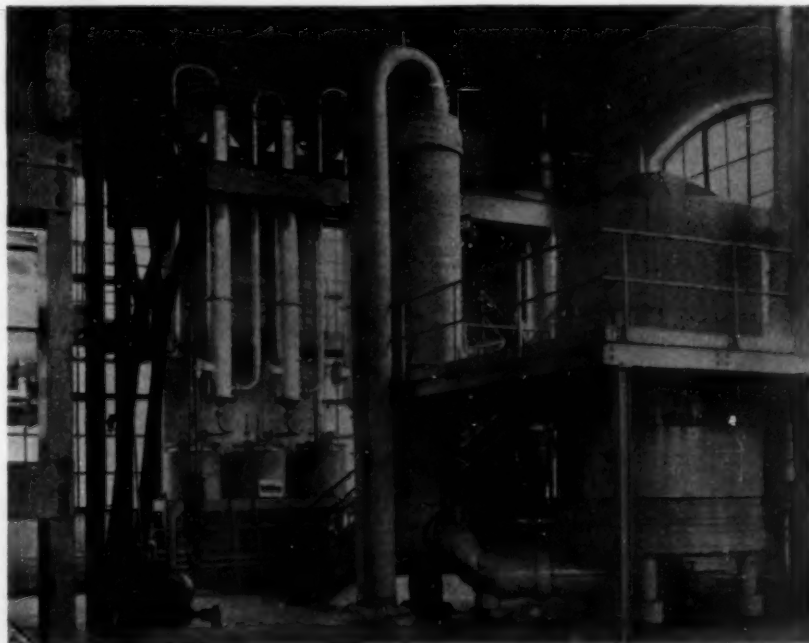


Photo by Acme

natural product in a number of respects. Tires are made from it by several German concerns and extended road tests have demonstrated their superiority. Buna is not affected by oils and acids, hence important industrial applications are indicated. A large-scale plant is already under construction.

Total consumption of motor fuel in Germany amounted to 2,000,000 metric tons in 1935. Of this quantity 1.22 million tons were imported, 350,000 tons were domestic benzol, 180,000 tons were alcohol used in admixture of 10 per cent, while the remainder was supplied by the hydrogenation of coal, lignite and tar and other sources. However, a number of important hydrogenation plants are under construction so that in the next few years there will be a considerable increase in the output of synthetic liquid fuel. A new process for liquefaction of coal has been developed by the Stinnes concern. The extraction takes place under pressure at gradually increasing temperatures from 300 to 450 deg. C. It is claimed that 85 per cent of the oil contained in the coal is extracted. This oil, poorer in hydrogen than ordinary diesel oil, is free from ash and may be used as motor fuel.

Coal-tar production increased about 12 per cent over 1934 to an estimated 1,350,000 tons. The demand was so great that stocks accumulated in former years were drawn upon and supplies of some products such as naphthalene, anthracene and carbasol were running short.

Production of dyes also showed a small increase over 1934 when the output was estimated at 76,000 tons, but values declined considerably. Fully

50 per cent of the production is exported. Pharmaceuticals extended their market as packaged proprietary preparations are being substituted increasingly for prescriptions. It is estimated that 80 per cent of the domestic market is accounted for by public-health insurance requirements.

The fertilizer industry showed considerable improvement of sales in all lines, both domestic and foreign. Increased efforts to stimulate domestic agricultural production in Germany resulted in fertilizer consumption in 1934-35 of 425,200 tons of nitrogen, 816,600 tons of K_2O and 542,000 tons of P_2O_5 . Exports in 1935 rose to 684,000 tons of nitrogenous fertilizers, 390,720 tons of K_2O , and 36,400 tons of superphosphate. Potash exports increased especially to the United States and Japan. Production of superphosphates was over 720,000 tons and 1,400,000 tons of basic slag were produced in 1934. A new fertilizer, ammoniated peat, was put on the market in 1935 and was of interest because of its combined content of potash and phosphate.

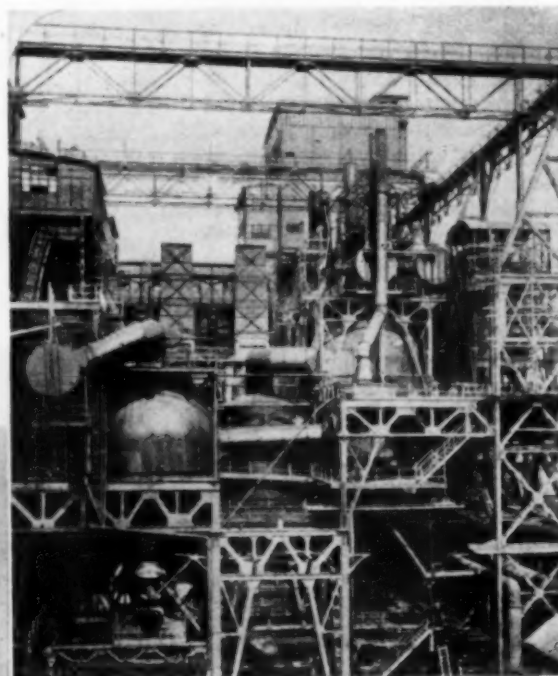
Production of alcohol from cellulose

was placed on a commercial basis during the past year. A pilot plant using the Bergius process is in operation and there is a larger plant producing 26,000 gal. of alcohol through the saccharification process of Schoeller-Tornesch. Output of both plants was taken over by the alcohol monopoly, a governmental institution.

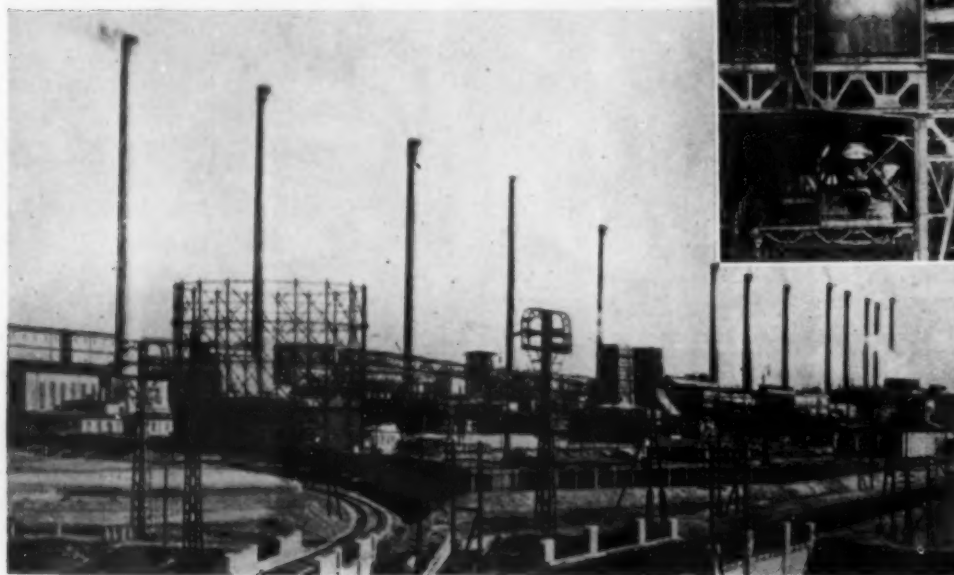
Undoubtedly the greatest progress has been achieved by synthetic resins. The production increased to about 25,000 tons or 50 per cent more than 1934. Exports amounted to over 5,000 tons. About 90 per cent of the output is of phenolic base, although carbamid resins are gaining in importance. Estimated production of synthetic resins in Germany as compared with the output in the United States in tons is shown in the following table:

Year	Germany	U.S.A.
1920.....	750	800
1925.....	3,000	6,000
1930.....	10,000	15,500
1933.....	19,200	22,500
Thereof: Phenol Resins.....	15,000	15,750
Urea-resins.....	1,000	1,600
Alkyd-Resins.....	3,000	5,000
Other art. resins.....	200	150

Winkler gas generators for producing hydrogen from brown coal for ammonia synthesis.



Leuna synthetic ammonia works of I. G. Farbenindustrie. Estimated maximum annual capacity (with Oppau) of more than one million metric tons of nitrogen.



Training Chemical Engineers In Germany

By Prof. Dr. A. W. SCHMIDT

Rector (president) of the Technical University, Munich (Germany) and director of the Institute for Chemical Technology and the Research Laboratories for Mineral Oils

This prominent educator sees necessity for revising existing curricula to give greater emphasis to increasing importance of the design and construction of chemical engineering equipment

GERMANY is still holding fast to her traditional system of training graduates for the chemical industry. This classic curriculum of the chemist has given positive proof during the last decades of being exceedingly well adapted to German conditions; it has created the type of German chemist whose achievements placed German chemistry in a leading position throughout the world.

Within the last few years, however, the impression is gaining ground that the increasing importance of design and construction of chemical equipment demands a revision of our curricula. This opinion asks the university to initiate the student in chemical engineering proper and to develop his understanding of the problems involved. It seems strange indeed that, formerly, chemical industry in Germany was opposed to any attempt in this direction. Industry was well aware of the significance of the subject; in fact, the companies themselves usually provided most careful training in the use of equipment and in operation of plants for the recent graduate. At present, however, the leading men of the large chemical concerns have adopted an entirely different viewpoint and are now advocating official recognition of chemical engineering in university curricula.

The Deutsche Gesellschaft für Chemisches Apparatewesen-Dechema—organized by Max Buchner, Hannover, in the twenties, is representative of those interested in these problems. The

society has its own publication, *Die Chemische Fabrik*, published under the auspices of the Society of German Chemists; and the Achema Expositions arranged in connection with the annual meeting have carried the name of the Society all over the world. The next is to be held in Frankfurt-a-Main in 1937. If progress has been achieved in this direction, the same cannot be reported in the educational field.

Every technical institution and many academic universities have courses in chemical technology. In most cases, however, they are restricted to a narrow field, the description of raw materials and their utilization for the production of goods for the chemical industry. Equipment and methods are subjects of minor importance. Judged by recent publications, it may be stated that this deficiency is recognized widely and that attempts are being made to improve conditions by creating suitable text books. The "Chemie-Ingenieur" by Eucken and Jakob and numerous collaborators is noteworthy as well as E. Berl's "Chemische Ingenieur-Technik," and the recent "Grundriss der Chemischen Technik" by Henglein. The two first named books are to be classified as reference works while Henglein is a text book for chemical engineers. The Kutzner translation of Badger and McCabe's "Elements of Chemical Engineering" has had a notable success. These publications have covered the serious lack of appropriate German literature in this field.

Professional publications have opened their columns to voluminous discussions on changes in the curriculum of our universities in order to respond better to the needs of modern chemical industry. Although quite acceptable, most of the propositions have remained on paper, unfortunately. Nevertheless, there is reason to anticipate many educational innovations in the field of chemical technology; changes are imperative and serious resistance is expected neither from industry nor from university interests. It may be pointed out that the Ministry of Education has approved and is supporting the reform movement.

One factor cannot be overlooked, however. Conditions essential for Germany in regard to the realization of such reforms have to be taken in consideration and given their due weight and place. For instance, the writer does not believe that the American way of training chemical engineers would be quite suitable for Germany; most certainly, any endeavor adopting this viewpoint would be doomed to failure. What we consider the best procedure is the following:

The student should first receive the thorough and broad education in inorganic and organic chemistry customary in Germany. During the advanced terms, this training should be supplemented by comprehensive technology not confined to purely descriptive considerations as is done at present but including fundamental theoretical and practical data, especially in regard to equipment. Laboratories with typical industrial equipment should facilitate tests, demonstrating the principles of the process as well as the operation of all the equipment. The chemical reaction itself should be considered of secondary importance; on the contrary, simple reactions should be chosen so as to permit the student to concentrate on the equipment involved.

At present, there are few chemical engineering laboratories of this type available in Germany. Nor does the writer now believe that, in the near future, every university could afford such institutes—neither does it seem necessary for the beginning. A few institutions so equipped will suffice to gather experience based on which later decisions can be reached as to the ways and means best suited for German chemical engineering education.

All problems relating to development of equipment and its design should remain primarily with the engineer as before; the chemist being given only a consulting voice. This, on the other hand, gives the chemist the right to demand better consideration in the curriculum of the engineer for the needs of chemical industry.

▼

Are Two Kinds of CHEMICAL ENGINEERS Needed in Germany?

By Dr. Ing. OTTO FUCHS

*Professor of Chemical Engineering,
University of Darmstadt, Germany*

▼

ONE might crudely define the chemical engineer as an expert with a training half chemical and half engineering. Should the processes of education proceed in this way, however, there would be grave danger of producing a chemical engineer who understood sufficient of neither chemistry nor engineering to be of much use to modern industry.

For some time certain German universities in collaboration with their chemical engineering institutes have trained chemists who later on were able to work effectively with the engineers in industry. They were taught the interpretation of technical drawings, knowledge of machine elements, simple mechanics and the principles of engineering construction—all in addition to their usual chemical training. However, very few institutions in Germany have such comprehensive curricula. The majority of men on the staffs of German chemical industries have been trained along different lines. They have studied pure science at the universities, then started their careers in the labora-

tories of industrial enterprises. There they have been given the opportunity of learning industrial methods and equipment, gradually acquiring the knowledge that makes an expert chemical engineer. Large enterprises could afford to keep those not suited for plant work in the laboratory, providing ample opportunities for research or control work. Such specialization, however, naturally interferes with efficient management of the smaller or even moderate sized concerns. They would much prefer a technically trained personnel equally adapted to work in the plant or the laboratory. This holds true in still greater measure for the very small company having but a small staff or, in the extreme case, where one man must be the "jack of all trades" or as we say, "Mädchen für Alles."

The present rapid trend of developments in the technology of chemical industry demands a different set-up. Our efforts must be concentrated on the training of suitable personnel provided with better and more efficient combination of technical and scientific fundamentals.

We must admit that the United States has been most successful in this endeavor. Your large, well-equipped universities and institutes of technology which are so competently staffed, are greatly assisting the student in acquiring his working knowledge of chemical engineering. The number of good American textbooks is deserving mention because Germany has produced very little comparable literature in this field except the Kutzner translation of "Elements of Chemical Engineering" by Badger and McCabe. Dr. John H. Perry's "Chemical Engineer's Handbook" is unrivaled over here.

It is not to be expected that in the future our chemical engineering training will proceed exactly as before by developing systematically the fundamentals of related branches of science. The increasing number of subjects would make the course too long, besides calling for a capacity of assimilation that few students possess. Therefore the time devoted to chemical engineering training has to be shortened. Only with the best of knowledge and experience can our educators undertake this task. They must view the entire field comprehensively and at the same time possess full knowledge of industrial requirements, a condition sometimes neglected during recent years.

All will agree that physics is the most important auxiliary science for the chemical engineer. But picturing chemical engineering as the sum of physical methods only is an entirely different matter and open to serious criticism. The viewpoint of the classical physicist is inadequate; neither are his methods

suitable for a comprehensive treatment of the extended field of chemical engineering. A case in the engineering art might serve as an example. The science termed "Chemical Thermodynamics" is not in the realm of the physicist but rather of the engineer trained in physical chemistry. Progress in this field is achieved by the combined efforts of engineer, physicist and chemist. In support of this contention, we would like to make one more observation. None of the various books such as Kremann, Schwab and Holluta, which discussed physical chemistry in its relation to industrial technique, has proved of great value to engineers although the importance of the field is self-evident. The reason, obviously, is that these books have been written by scientists specialized in a comparatively narrow field and their work does not have sufficient appeal for prospective chemical engineering readers. In the few cases where at least a moderate success has been attained, one of the more general textbooks might have succeeded just as well.

Where chemical engineering training is to be given to students who have already had an engineering education, it is our belief that the ideal teacher is an engineer with wide experience in chemical industry. He is best suited to impart the understanding of chemical reactions in their larger scope and in their relations with other fields. The students will better understand his language and it will be easier for him to transmit the basic ideas than would be the case with a chemist familiar with all these phenomena by long academic training but without experience in their industrial application. Preliminary or simultaneous instruction in the fundamentals of chemistry must, of course, remain with the chemical teachers. Likewise, it is our belief that a chemist possessing wide experience in industry is the best possible teacher for the training of the student chemist who is to become a chemical engineer.

One objection to these proposals will be that they will tend to create two kinds of chemical engineers according to the basis of their training. This should not necessarily be a disadvantage. Further developments will determine whether or not chemical engineering in Germany is to progress toward a single harmonious art, combining essential parts of both chemistry and engineering. That this whole subject is one that is receiving study and is appreciated in important places in Germany is well illustrated by the recent publication of the fine book by Prof. F. A. Henglein of the Technical University at Karlsruhe entitled "Grundriss der Chemischen Technik" (Verlag Chemie, G.M.B.H., Berlin).

Recent Improvements Reflect Trend In German Chemical Equipment

By SPECIAL CORRESPONDENCE

Berlin, Germany

FOR A NUMBER of years, designers of chemical equipment in Germany have been confronted with difficult problems that could be solved only by combining scientific investigation with high ability on the part of the designer. Numerous examples of pioneer achievements are to be found, especially in connection with large scale syntheses such as ammonia, liquid fuel and methanol and in the saccharification of wood. Difficulties have been accentuated by the need for efficient, low cost production, for flexibility as regards raw materials and adaptability to variable markets.

Research into the chemical and physical fundamentals of certain phases of chemical engineering is progressing continuously, influencing in turn the design of equipment. Recent work on heat transfer in evaporators, using both superheated and saturated steam, has been productive, as have investigations of drying from the standpoint of air movement, moisture diffusion and particle size. Much work has been done on rectifying columns with regard to heat transfer and pressure drop and

the conditions surrounding separation of mixtures by azeotropic distillation. Particle size distribution studies have been carried out in the case of grinding equipment of various sorts, while special mill types, including drying grinders, have been investigated.

In the space available nothing like a complete digest of recent equipment developments is possible and only the most striking of recent improvements can be touched on. In fact it has been necessary to omit reference to whole groups of unit operation equipment but such omission should not be taken to imply any lack of progress in these fields.

Much work has recently been done by the German steel industry in the further development of corrosion resisting alloy materials as well as in those for heat and caustic embrittlement resistance.

New improvements in jacket construction for kettles have made possible the use of hitherto totally infeasible steam pressures. One new construction element has been devised which is developed from the well known staybolt.

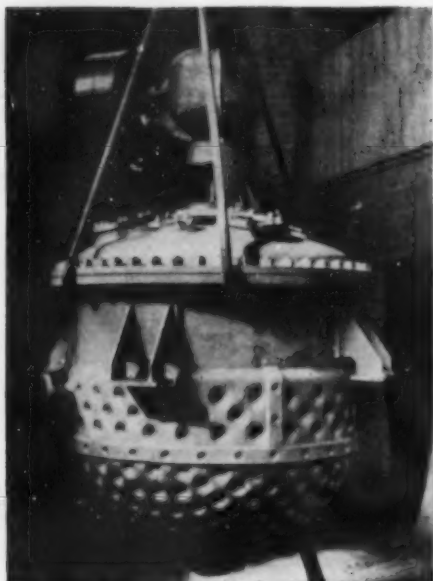
It is designated as the double wall staybolt weld and is the product of Samesreuther & Co. G.m.b.H., of Butzbach. As appears from Fig. 2, the inner vessel is provided with a steam jacket which has circular openings embossed upon it, the rims of which are welded to the vessel. Such a connection between jacket and vessel is superior even to the staybolt because the wall of the container is not punctured, thus obviating the danger of corrosion around the opening. Heat transfer is considerably improved in comparison with the usual jacket construction, offering a safety factor against rupture of 20, according to tests on a vessel designed for 600 lb. operating pressure. The construction permits reducing the wall thickness of the inner vessel since the jacket provides structural strength. Pressures up to 1,100 lb. have been handled safely.

Still higher steam pressures, up to 3,650 lb., have been used with another construction developed by the same firm and shown in Fig. 3. A special process for welding the coil to the vessel is employed, permitting the use of minimum wall thickness and offering the advantage of ready replacement of the heating coil in case of failure. Test vessels of pure nickel (40 gal. capacity, 10.8 sq. ft. heating surface) showed a heat transfer of 177 B.t.u. per hour, square foot and degree F. to boiling water at an average steam temperature of 290 deg. F. Such coils are of distinct advantage on vessels of plated material as it is easy to connect the coil with the base metal without damaging the plating.

In the field of drying, the trend has been toward lowering steam consumption, operating time and dryer size. Utilization of pulsating pressure (a development of the I.G., which has been commercialized by Benno Schilder A.G., of Hersfeld) has permitted a notable decrease in the time needed for drying, particularly by increasing the rate of moisture diffusion in the falling rate period. Air pulsation of about 4 in. w.g. causes a kind of breathing of the material hastening delivery of the moisture to the surface. Two methods are used to set up pulsations at the rate

Fig. 1—Portion of exhibit floor of the "Achema" exposition held in Cologne in 1934; the next exposition is scheduled for 1937





of 20-100 per minute. One is to employ a single high-pressure fan which is connected alternately by dampers to the two chambers of the dryer. The other is to use a pair of double-acting pistons placed on top of the drying chambers. Generally, drying time can be reduced as much as one-third by this method. The advantage is most pronounced in the case of relatively porous materials.

Recently, progress in screening has been made through a study of the best type of motion to be imparted to the particles. The conclusion has been reached by the Carl Schenk Eisen-geiserei u. Maschinenfabrik, of Darmstadt, that the best motion is that produced by a spring-supported screen surface elliptically vibrated by a rapidly rotating unbalanced weight. With this movement, the material is shaken thoroughly, the mesh remaining clear, thus insuring good efficiency. As the motion contains a component in the direction of the flow, it is feasible to reduce the inclination of the screen below that of the usual gyrating or vibrating screens.

Even drum type screens in recent constructions have incorporating devices to provide additional oscillation for the screen surface. A new centrifugal vibratory screen has vibration imparted to it by unbalance of the screen drum. When screening sulphate of ammonia with 20 per cent dust at the rate of 6.6 tons per hour, the screen has shown an efficiency of 98 per cent.

Among discontinuous filters the new Sauerbrey-Jung candle filter, which uses porous ceramic material instead of cotton, wool, silk, wire or rubber cloth, should be mentioned. Quartz-filled phenol plastics, quartz and fireclay, and carbon filter elements are used. Extremely difficult filtrations are possible.

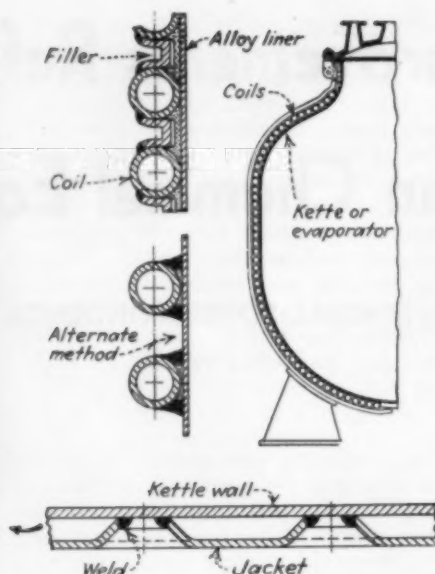


Fig. 2—At left is shown a kettle of the "double-wall" staybolt type, with the construction detailed above

Among continuous filters, notable improvements have been made in the rotary vacuum type, the inside type (cf. Dorco filter.—Ed.) and in clarifying filters employing an asbestos fiber filter element which is produced by washing finely divided asbestos fibers onto a large-mesh support.

An extremely novel development is that of flexible filter stones which may be installed instead of filter cloth without any modification of the filter plates. These have been brought out by Filtersteinfabrik Wilhelm Schuler G.m.b.H., of Grünstadt. They are of square or rectangular shape, for instance 4x4 in., joined by elastic links so as to provide a flexible surface that can be installed

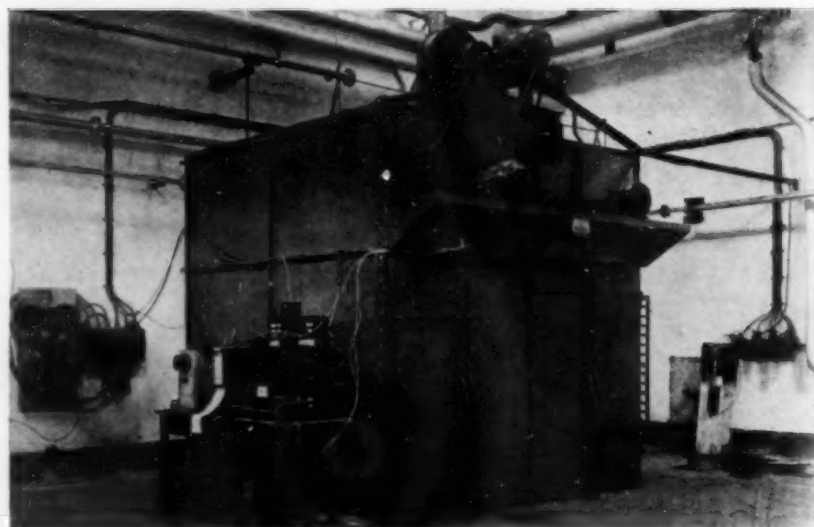
Fig. 3—Detail of kettle construction with heating coil welded to the kettle wall

without difficulties in existing filter presses. Since the stones are acid and alkali resistant, it has become possible to filter sludge on filters which previously could not have been used for this purpose. Another advantage is that sludge which yields too wet a cake with usual methods may be pressed harder, leaving a much drier residue. Furthermore, this method facilitates removal of the cake.

In the case of centrifugal extractors progress has been achieved through improving the means for removing the material after centrifuging. Experience has shown that the usual plow, extending over the entire width of the basket, is inadequate, especially for the removal of certain sticky materials. A new device shaped like a spoon has been developed by C. G. Haubold A.G., Chemnitz, so designed as to oscillate, cutting off a thickness on each reversal. The speed of the spoon is adjustable, as well as the cutting thickness. An automatic device stops the spoon after removal of all material. This construction is used to great advantage for crystalline products which it disintegrates less than does an unloader of the plow type.

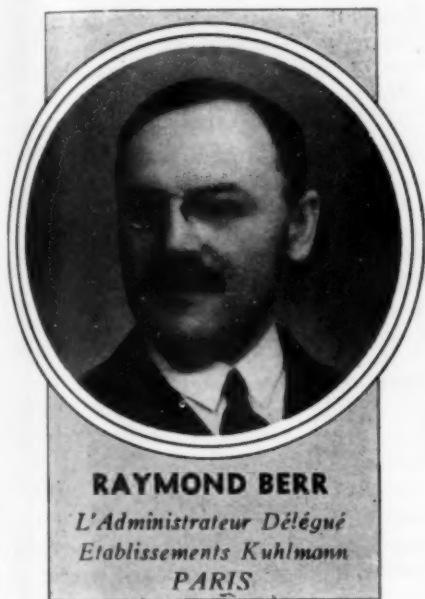
The same concern has introduced another innovation, a hydraulic automatic control for the various steps of the working process. The charging period is regulated by setting a hand wheel and may be changed during operation. Adjustment for other steps is provided also. Still another development is a device for equalizing the distribution of the material in the basket as well as for controlling the inlet valve.

Fig. 4—Double-chamber dryer equipped for pressure pulsation, using a high-pressure fan



FRANCE

Since the War, France has attained a leading position in world chemical manufacture. The following pages give an opportunity to trace the rise, as it applies to the industry, the profession and education in chemical engineering



FRANCE STANDS FOURTH IN WORLD CHEMICAL PRODUCTION

By E. SELLIER

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IN 1913, the products of the German chemical industries were valued at three times those of France. During and since the War, however, French industry has undergone important developments. The increase of chemical production since 1914 may be estimated at 30-40 per cent, but certain branches, as for instance, the synthetic nitrogen industry, have made a much greater advance. At present, France with a yearly output valued at approximately \$670,000,000 is in fourth place in world chemical production, being exceeded by the United States, Germany and Great Britain. Among its own industries, chemicals occupy fifth place, being preceded by machinery, metals, cotton and wool.

In contrast to Germany, the French chemical industry has been built in order to provide for the home market only. From 1928 to 1931, exports amounted to 25 per cent of the total production, while imports were less than 15 per cent. Nevertheless, exports were valued at \$200,000,000 in 1929, declining to somewhat over \$100,000,000 in 1933, at that time amounting to 7½ per cent of the total French exports.

The World War has caused important changes in the sources of raw material.

Since 1926, the Alsatian mines have furnished a considerable surplus of potash, and the resources of French colonies have been of increasing importance. Tunis, Algeria and Morocco have provided an abundant supply of phosphates.

In coal mining, the French share of world production is moderate with about 50,000,000 metric tons out of a total of 1,200,000,000 tons; it is necessary to import about one-third of the needed quantity. Electric energy—production of which is estimated at 13 billion kw.-hr.—is supplied to a considerable extent by hydroelectric plants. Production of alcohols to the extent of about 80,000,000 gal. is more than sufficient for the needs of the country. Pyrites has to be imported, the one French mine at Sain-Bel (Rhône) supplying only 200,000 tons per year. A similar condition exists in regard to sulphur for the French production amounts to but 1,200-1,400 tons yearly. The production of salt is in the neighborhood of 1,500,000 tons, fluor-spar 50,000 tons, and bauxite 500,000 tons, of which half is exported—in other words, France is self-supporting for these three raw materials. On the other hand, there are a number of metals that are of outstanding importance from the

chemical engineering viewpoint but for which France must rely on imports; for instance, copper (2,500 tons), lead (24,000 tons), and zinc (100,000 tons). New Caledonia is able to supply 60,000 tons of chrome ores and 70,000 tons of nickel per year.

Although chemical industries are distributed all over France, there are a few centers of concentration near Paris, Marseilles, Lyons and Rouen, and in the North in proximity to the coal mines. Other important sites are to be found in the Alsace because of the potash mines, the oil wells and the textile dyeing industry, and in the Lorraine with its salt beds and related industries as well as its metallurgical industry with its byproducts.

The number of establishments—there were 1,100 in 1932—shows a decided tendency toward increasing concentration into fewer but larger plants. The chemical industry includes about 200,000 wage earners, and has a total capital investment of 12 to 15 billion francs, with very small foreign participation.

Compared with American, British or German chemical industry, France seems to have a great many small or moderate-sized establishments. Nevertheless, there are several large concerns



Nitrate of soda storage in Kuhlmann's La Madeleine plant

1933 15,700 tons of 100 per cent acid was made. This is also the case for hydrochloric acid; the production, although smaller than in 1913, is about 100,000 tons. Chlorine and its products are produced in more than sufficient quantities for the home market—about 25,000 tons of liquid chlorine—and leave a considerable surplus for export.

The manufacture of soda and its derivatives also leaves an important balance for export. The production of caustic is estimated at about 110,000 tons of which one-third is exported; of 450,000 tons of carbonates produced, 100,000 tons is exported; the production of sulphates amounts to about 60,

Nitrogenous Fertilizer Production in France

Year	Ammonia Fertilizers	Nitrate Fertilizers	Compound Fertilizers	Cyanamide	Total Nitrogen
Production, Metric Tons Nitrogen					
1931-32.....	77,011	9,539	6,292	8,902	101,744
1932-33.....	77,593	18,216	19,536	9,120	124,465
1933-34.....	74,573	30,983	25,587	8,245	139,388
1934-35.....	65,152	39,777	20,778	5,993	131,700
Consumption, Metric Tons Nitrogen					
1931-32.....	182,746	69,271	4,534	8,555	164,106
1932-33.....	75,965	57,104	16,023	9,064	158,156
1933-34.....	71,733	54,444	22,087	8,245	156,509
1934-35.....	57,922	42,902	22,634	5,993	129,451

with diversified production; Kuhlmann, Saint-Gobain, Solvay and Bozel-Maletra in the heavy chemicals groups; Alais, Froges & Camargue controlling 90 per cent of the production of aluminum; the Société d'Electrochimie & des Acieries d'Ugine in electrochemicals and electrometallurgy; L'Air Liquide for the various applications of the processes of Claude for liquefaction of gases, for acetylene and ammonia; and Rhone-Poulenc in drugs, pharmaceuticals, fine and pure chemicals. The production of dyes is an old industry and is mainly in the hands of Kuhlmann and the Société des Matieres Colorantes de Saint-Denis.

The Etablissements Kuhlmann, with a capital of 316,500,000 francs, manufacture in their 19 plants—without counting numerous affiliates—a comprehensive line of heavy chemicals, glues and adhesives, dyes (of which they control the French production), synthetic resins, solvents, synthetic fuels, fertilizers, insecticides, mineral dyes, and drugs and pharmaceuticals. Partly in collaboration with important mining concerns, Kuhlmann has assumed leadership in the fixation of atmospheric nitrogen, the production of synthetic nitric acid and nitrates, as well as in the syntheses of alcohols and liquid fuels. The plant at La Madeleine-lez-Lille (Nord) is the largest producer of synthetic nitric acid in France.

The Compagnie de Saint-Gobain, with a capital of 310 million francs, is the main glass producer of France, besides manufacturing a great variety of industrial and agricultural chemicals. It shares with Kuhlmann the predominant

position in the production of superphosphates, and, recently, has acquired a large interest in the oil refinery erected at the Etangs de Berre.

Bozel-Maletra, capitalized at 100 million francs, is an important producer of calcium carbide and ferro-alloys, together with a great number of other electrochemicals of mineral base.

Solvay specializes in carbonates and caustic soda but also manufactures chlorine products. The Société d'Electrochimie d'Ugine has over 20 plants, situated mostly in the Alps. Its chief production comprises special steels and a variety of ferro-alloys, but includes also chlorine products, hydrogen peroxide, light metals and various other electrochemical products.

In 1921, the French chemical industry organized an association, the "Union des Industries Chimiques." In further defense of their interests, some 20 of the more important concerns set up the "Comité des Industries Chimiques de France" in 1927.

The production of sulphuric acid reached a peak in 1929 with about 1,500,000 tons; since 1931, this output has declined to between 800,000 and 900,000 tons of which two-thirds is produced by Kuhlmann and Saint-Gobain. The former uses a vanadium catalyst, having successfully perfected this process. Pyrites is the main raw material of which 450,000 tons is imported in addition to the 200,000 tons mined in France at Sain-Bel and 100,000 tons of blende.

Nitric acid is produced in sufficient quantity to cover all domestic needs. In

000 tons. The output of copper sulphate has been considerably increased during the last few years and now satisfies the demands of all France, including Algeria.

The greatest progress has been achieved in the nitrogen fertilizer industry. In 1913, the French industry could supply only 25 per cent of the consumption, while at present it can supply the entire demand. The accompanying table presents the figures for production and consumption for the last few years. These figures show that France has become entirely self-dependent so far as ammonium sulphate is concerned; importation of nitrate fertilizers, restricted since 1931, is limited to the Chilean product, although even this could be dispensed with.



The production capacity of the French nitrogen industry was estimated at 240,000 tons N_2 for the last fertilizer campaign. Of this amount, 20 per cent is supplied by the Toulouse plant of the Office National Industriel de l'Azote. Independent of the government's plant at Toulouse, which uses the Haber-Bosch process, the private industry has installed plants for ammonia synthesis according to the Claude, Casale, Nitrogen Engineering Co. and Mont-Cenis processes. Production is prorated with a minimum sales quota reserved for Toulouse.

Of the production of potash 70 per cent is in the hands of the government which is exploiting the Mines Domiales de Potasse d'Alsace turned over to the country after the War; the remainder is supplied by a privately owned concern, Kali-Sainte-Thérèse. Both producers have pooled their sales organization in the Société Commerciale des Potasses d'Alsace which entered into an agreement with the German producers in 1926 reserving to each group its national territory exclusively but dividing the export markets. The agricultural depression has forced a pronounced curtailment as in other lines; production has fallen to 320,000-350,000 tons of K_2O during the last few years, thus giving France second rank after Germany but before the United States. As France uses between 200-250,000 tons, there is, of course, a large surplus for export.

Almost all of the imported phosphates come from Northern Africa whose production of about 3,200,000 tons constitutes over 50 per cent of the world output. In 1934, France imported 950,000 tons of phosphates. The production of superphosphates of which 2,000,000 tons had been produced yearly since 1913, had declined to 1,380,000 tons in 1933. At the same time, there arose an import surplus of between 50,000 and 100,000 tons while formerly there always was an export balance.

The glue and adhesives industry has an annual production of 30,000 tons of superphosphates derived from bones and 7,000 tons of glue, 1,500 tons of bone gelatine, 4,000 tons of skin glue and from 1,500 to 2,000 tons of skin gelatine.

The dye industry is another illustration of the great development of chemical industry in France since the War. In 1913, France used 9,000 tons of dyes of which 7,000 tons was produced on French territory in ten plants, six of which, however, were owned by Germans. At present, the output amounts to 15,000-16,000 tons, all produced in French owned establishments; 3,000-5,000 tons is exported giving France fourth place, or the same as Switzerland, in the world trade. A number of new intermediates have been developed during the last ten years, completing the scale of basic and sulphur dyes. New dyes have been perfected in the azo group, vat dyes, naphthazols, and so forth.

Before the War, France was dependent upon Germany for pharmaceutical products. At present, about \$3,400,000 worth of pharmaceuticals (without taking specialties into account) is exported per year. Unfortunately, the French products encounter serious competition in foreign markets, in addition to the tariff barriers and quota restrictions that have played havoc with international trade in general during the last few years.

The bromine industry has been well established since 1926, thanks to the Alsatian potash mines. Mention should also be made of the importance of the production of synthetic perfumes that has, in normal times, a value of \$8,400,000 and is mostly destined for foreign markets.

The production of charcoal has definitely lost its pre-War prosperity on account of synthetic products; the wood chemical industry has a capacity of 70,000 tons of charcoal, 1,200,000 gal.

of methanol, and 12,000 tons of acetic acid.

Coal distillation at present supplies 600,000 tons of tar, 350,000 tons of which is used for road construction, the remainder being distilled further to furnish the raw material for organic syntheses. In 1934, 74,000 tons of benzol was produced.

Great progress has been made in the plastics industry. From a modest beginning in 1918, the production of synthetic resins has increased to 1,500 tons at present, besides 110,000 tons of rosin, 30,000 tons of turpentine, and 40,000-45,000 tons of casein. Of the demand for industrial paints and varnishes 85 per cent is supplied by the home industry. Production of crushed barite has been increased fourfold since the War to 40,000 tons and that of lithopone has grown from 1,500 tons in 1913 to 30,000 tons in 1929. The annual consumption of nitrocellulose lacquers is estimated to be about 1,500-2,000 tons.

Special mention should be made of the industry that has been developed by collaboration of the coal mining and heavy chemical industries in order to utilize coke-oven gases to the utmost. The Compagnie des Mines de Béthune and the Société de Produits Chimiques Courrières-Kuhlmann produce methanol, as well as higher alcohols and solvents.

Recently, the synthetic liquid fuels have been produced on a large scale. Although government as well as private industry has investigated this field for many years, there has been hesitation in entering the field on a large scale because of the enormous investment necessary. However, a pilot plant with a daily capacity of 50 tons of coal, using the Valette process, was put in operation a few months ago, at the Mines de Béthune. Another plant is being erected at Liévin using the Audibert process, also of French origin, while Kuhlmann is building a plant using the Fischer process with a yearly output of 25,000 tons of liquid fuel.

Panorama of Kuhlmann plant at La Madeleine-lez-Lille (Nord)



French Industry Found Depression Still Severe in 1935

By **M. KALTENBACH**
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DURING 1935 the French chemical industry had a difficult year. The depression which struck France later than other countries, continued for a longer period. That this has been the case is not the fault of France but rather due to a series of circumstances over which the country has had no control.

For one thing, the return of the Saar to Germany has meant the loss of important markets for the chemical industries of the North and the East. Further than this, devaluation of the Belgian currency, following that of the pound, caused increased competition with Belgium and Britain, while competition with American, Japanese and Russian products increased in the home markets. At the same time our best customers—Germany, Britain and Italy—are now restricting our exports to an increasing extent by higher tariffs.

Still another factor has been the instability of the foreign exchanges, making exports more difficult; exporters have not been overly anxious to make shipments without assurance of the return of their billings. Finally, the sanctions applied against Italy have had serious repercussions on the chemical industry.

Although a dangerous practice, it seems understandable to appeal for assistance from the government when business is so poor. But such governmental intervention is never given without exacting a return, for if the government gives with one hand, with the other it takes away at least some freedom for self-determination of industry. It is in this way that state socialism advances step by step—in the settling of labor questions, in the financing of industries unable to stand on their own feet. At best such palliatives can only retard the inexorable development of world-wide economic forces.

Numerous are the discussions one hears of the advantages and disadvantages of the various systems that have been applied in neighboring countries; the corporate state in Italy, the state industry in U.S.S.R., and the late-lamented NRA in the United States. Nevertheless, the old liberalism, with its record of achievement, is still alive in France, and private enterprise is well represented at the council table.

In the face of all these difficulties, chemical industry is endeavoring to

consolidate its position, at least to hold its own. So far, it seems to have been able to show gratifying results.

In order to stimulate new developments, the Société de Chimie Industrielle organized the Centre de Perfectionnement Technique to disseminate among its members knowledge of new methods and processes. This move has met with general approval and can be considered a great success.

Our heavy chemical industry has continued to concentrate its plants. Progress in electric power transmission over long distances has aided this movement. A great number of smaller plants are being shut down, resulting in considerable operating economies.

The Kali mines, owned by the government, have been given corporate status with full financial autonomy. Profits are distributed as follows: 10 per cent to social service, 71 per cent to the national treasury, 12 per cent to the three Alsatian "counties," 7 per cent to share holders, and 10 per cent to farm organizations. Potash prices have been reduced 8 per cent in 1934 and 5 per cent in 1935. New potash fields have been discovered in the Pyrenees but will not be exploited under present conditions.

Several new plants for nitrogen fixation have been put in operation, incorporating the latest developments. They are designed for the direct production

of 60 per cent nitric acid, using compact equipment at atmospheric pressure. New plants are still under construction and others are undergoing modernization.

Two plants are operating for the production of concentrated nitric acid by combustion of ammonia in pure oxygen.

The concentration of weak nitric acid by sulphuric acid without steam injection has been perfected, reducing the consumption of 96 per cent sulphuric almost to the theoretical amount. The remaining weak sulphuric is reconcentrated under vacuum using equipment of extremely simple design and at an efficiency closely approaching the theoretical limit. A similar process is used for the denitration of the mixed acids originating in nitrocellulose or other explosives plants.

New mineral resources have been discovered in France, promising profitable exploitation under different economic conditions. In this connection, we mention zinc, lead, tungsten, gold—seven gold mines are producing about 5,000 kg. at present—barium sulphate, calcium fluoride, lepidolite with 7.5 per cent Li_2O , sulphur, antimony, magnesite and cobalt (in Morocco).

The phosphate mines of Northern Africa suffered keen competition from Russia and Egypt.

The Alsatian oil wells furnished about 80,000 tons of crude, for a total consumption of over 2 million tons. New drillings were not successful but shale deposits have been found. On the other hand, oil refining has progressed by leaps and bounds, 15 refineries are in operation with over 5 million tons yearly capacity, part of which is used for exports. The construction of these plants has given orders to the mechanical industry amounting to 100 million dollars.

War Gave Impetus to Chemical Engineering Development

By **ANDRE CLAUDE**
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CHEMICAL INDUSTRY in France owes its great development to the War and its necessities. Until that time, only a few of the French schools had courses in chemical engineering but their graduates were adequate to head the staffs of the industry as then constituted and limited to the production of heavy chemicals, chlorates, metallic salts, fats, natural essential oils, dyeing and tanning extracts,

charcoal and coke, tartaric products, glue and gelatine. Chemists and mechanical engineers completed the ranks.

A new situation was created by the exigencies of the War and after the Armistice great numbers of chemical engineers were needed for the permanent establishment of the chemical industry, recognized as it then was as one of the key industries. New graduate schools, most of them in connection

with universities, were opened all over the country to prepare students for this career.

The alumni associations of some of the best schools initiated a movement to uphold the high standing of their profession which they felt to be menaced by the influx of recent graduates not sufficiently prepared. Their efforts centered on a uniform curriculum as well as on supervision of graduation requirements. They were supported in this by the two Institutes in Paris (established in 1882 by Schützenberger, and 1896 by Friedel, respectively), by those at Nancy (1889 by Haller), Lyon and Bordeaux and by the Syndicate des Ingenieurs Chimistes Français of which the Société des Chimistes Français had also become a member. The alumni of these Institutes, having advanced to executive positions, were well aware of the deficiencies in the curriculum. Their influence is responsible for increased allotment of time to the subjects of mathematics, designing, mechanics and electricity which are indispensable to the chemical engineer in addition to his knowledge of chemistry. Thus he is distinguished from the graduate in chemistry who, although he may have followed a course of industrial chemistry conveying a general idea of the subject, has omitted entirely those steps necessary to familiarize him with the industrial realization of laboratory tests and the problems that such development raises.

Both lines of training are necessary for chemical industry, each being worthy of protection and recognition as a separate profession. This recognition has at last been accorded by a law of July, 1934, defining and protecting the titles.

However, the graduate cannot rest on his laurels. While his training enables him to assimilate and bring to fruition discoveries called to his attention for the improvement of production methods, he cannot possibly hope to cope with the flood of publications concerning even his own field that the continuous progress of science pours forth from every corner of the world. A number of professional organizations have undertaken the important task of correlating this information, such as the Société de Chimie Industrielle, with its numerous sections. The Syndicate of Chemical Engineers is concerned exclusively with the profession as such.

In November, 1934, the Maison de la Chimie was founded for the professional development of the graduate chemical engineer. The funds are secured by a tax on apprentices and from the Department of National Education. The Centre de Perfectionnement Technique organizes every year a series of lectures by outstanding ex-

perts discussing recent scientific developments and their relation to industrial applications, new industrial equipment and materials. A complete reference service and library are facilitating research in every field.

Evening lectures and correspondence courses are also held, as a means of furthering the profession and assisting advancement to executive positions.

The training of competent chemical

engineers means furthering the interests of the country. It is for this reason that the chemical engineering profession has sought legal protection upholding its high standards.

The progress of French chemical industry, complementing the country's strength in agriculture and metallurgy, is due in no small part to the adaptation of the chemical engineer to the exigencies of his profession.

French Engineering Training Is Graduate School Function

By PROF. A. TRAVERS

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SUPERVISION of the operation of chemical plants, and their direction, are the functions of the chemical engineer. His training must, therefore, include full knowledge of the plant laboratory as he is called upon constantly to improve and rationalize production methods in order to reduce costs while maintaining quality. A broad education in science should facilitate and sharpen his critical faculty for the investigation of new methods and utilization of byproducts as well as for the initiation of new ideas.

At the same time, the chemical engineer should also get the training enabling him to act as a commercial representative. He can fill such a position, however, only after he has acquired experience in the plant qualifying him to serve as a useful link between manufacturer and consumer.

The chemist working exclusively in the plant laboratory does not need such a general training; his requirements are chiefly concerned with analytic methods, physical as well as chemical. But the research chemist should possess as wide an horizon as possible, enabling him to investigate new problems from every angle that modern science has put at our command. Moreover, he should be in constant touch with the plant and be able to improve manufacturing methods or, at least, to carry through his laboratory work into industrial realization. Necessarily, he should have some engineering knowledge.

France has about 20 graduate schools, mostly connected with universities, which provide full courses in chemical engineering. The rules for admission are not uniform but, in general, passage of the requirements of the bachelor's degree in mathematics is req-

uisite. Final selection is based on elimination during the succeeding three years by examinations deciding on the advancement to each upper class.

The writer is of the opinion that it would be preferable to rely on a severe entrance examination for admission, at the same time raising the age limit. This would guarantee the greater maturity necessary for the study of experimental sciences as well as a homogeneous student body of the highest caliber. Instruction could then be carried on much more efficiently.

All industrial leaders are agreed on the necessity of a thorough training in mathematics, applications of physics to chemistry becoming more and more important.

Time given to laboratory work should be at least equal to that devoted to theoretical instruction. Points to be stressed include detection of the causes of errors and the degree of approximation attained in measurements, thus developing the critical faculty of the student. Laboratory work should not be broken up too much, and three consecutive hours are to be considered a minimum. The student ought to work by himself, supervised, of course, by the instructor.

Other requirements for the chemical engineer are sketching, correct interpretation of plans and drawings, design and calculation of equipment implying a certain knowledge of materials and their characteristics.

Plant experience during the course is an absolute necessity (in fact, three months at least is compulsory—Ed.) in accustoming the student to the requirements of industry, its discipline and the inevitable monotony of routine work. This stage may well be the best means of arousing the student's interest in pure science.

Switzerland

CHEMICAL INDUSTRY in Switzerland withstood the recent world wide commercial and industrial depression with a great measure of success, thanks to the inherent resilience of its scientific, technical and commercial resources. The ground which this branch of industry lost in the immediate post-War slump and also in the more recent trade depression has now been largely recovered by virtue of new discoveries and opening out into new fields of activity.

The great importance of this branch of Swiss industry can be illustrated by the fact that according to the Swiss Year Book statistics, the chemical industry, including the manufacture of aluminum, comprises 439 limited companies with a total capital of 90 million dollars (present exchange) while for example the textile industry includes 308 companies with about 74 million dollars capital and the watch and clock industry, 499 companies with about 34 million dollars capital.

In addition to the large firms which have been taken into account in the above particulars there are a great number of smaller works which manufacture a number of commodities used in other industries and which find a market in every branch of industry.

The important part played by the chemical industry in the export trade may be gaged from the accompanying figures representing the value of the principal Swiss exports for the years 1929 and 1935. These figures show that the export of products of the chemical industry has fallen less than products of other industries and today the chemical industry holds the premier position in the Swiss export trade with almost one-fifth of the total export. This article deals only with those branches of the chemical industry which are characteristic of Switzerland and depend primarily on export trade, of which the most important are the coal tar color, pharmaceutical, perfumery, electrochemical and aluminum industries.

Coal Tar Colors—The beginning of



SWISS CHEMICALS RECOVERING

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the Swiss coal tar industry dates back to the middle of the last century. Its origin and development can be attributed to the importance of Basel as the center of an old established and well developed silk dyeing industry, and also to the influx of French chemists who were unable to put their discoveries to practical use owing to French patent laws. The first aniline dyeworks was established in Basel, and Geneva followed suit somewhat later. Basel has remained up to the present day the most important town in Switzerland for the manufacture of dyestuffs and this fact is due to its favorable geographical position as a commercial center and to the presence of important textile and allied industries in Basel itself and in the neighborhood, e.g., the cotton industry in Alsace and Wiesental.

Well equipped schools of chemistry, in particular the Federal Institute of Technology in Zürich, were of great importance in the development of a

Swiss dyestuff industry. These academic institutions were the source of supply of the highly qualified scientific, technical and commercial personnel responsible for the inception and maintenance of the dyestuff industry.

The Basel dyestuff industry soon developed into a typical export industry, the largest part of the production being sold in the neighboring lands, and in England and North America. India and Japan were soon added to the list of customers. Dyestuffs to the value of nearly 3 million dollars were exported in 1900, while the figure rose to over 6 million dollars in 1914. During these 15 years, the range of acid and chrome dyestuffs for wool dyeing was extended, and also the sulphur and vat colors were discovered, which proved of great importance for the production of fast shades on vegetable fibers. The Basel works played an important part in these discoveries.

The World War created conditions which extended the field of activity of

the Basel dyestuff industry. The supply of dyestuffs from Germany was suddenly cut off, resulting in a considerable increase in the demand for Swiss dyestuffs. The Basel factories were able only gradually to meet this increase in trade, as Switzerland no longer had access to Germany and other belligerent countries which had been important sources of raw materials and had to find new sources of supply. As the War progressed Switzerland succeeded in considerably extending its manufacture of intermediate products and eventually was successful in becoming practically independent of foreign supplies, which considerably strengthened its position during this trying period. Exports increased steadily during the war years and the immediate post-war period, and in 1920 reached their maximum with a total of more than 42 million dollars. But at the end of 1920 the world crisis in the textile industry resulted in a decrease in the value of exports in 1921 by a third.

Following experiences during the World War, the majority of industrial countries commenced to build up their own dyestuff industries. Many works which previously manufactured war materials changed over to the manufacture of dyestuffs and pharmaceutical products after peace was signed, with the result that new business conditions were evolved. Dyestuff factories, many of which were of great importance, were founded in France, England, the United States, Holland, Italy, Spain, Czechoslovakia, Poland, Russia and Japan, and were helped by the imposition of customs and import regulations in these countries. As a result the Basel dyestuff industry was forced to concentrate more on the valuable specialty products as the newly established competitive firms had naturally not developed to the same extent and at first were only manufacturing the simpler products no longer patented.

THE dyestuff industry was affected by the world industrial crisis at this stage in its development. In spite of the fact that turnover temporarily depreciated to a considerable extent owing to the serious crisis in the textile industry, Switzerland was able to hold its own in the world markets. The net result can be considered satisfactory when one takes into account the depreciation in the value of exports of other branches of trade which took place during the crisis. The present value of exports of dyestuffs is somewhat over 21 million dollars. This figure does not give a complete indication of the importance of the Swiss dyestuff industry, as Switzerland has branch works in France, England, United States, Germany, Italy, Poland, which play an

important part in their respective markets. These works were extended considerably during the crisis period owing to import regulations and difficulties, and at the present time represent an important part of the Swiss export trade.

Today difficulties in international trade still remain to a marked extent, and the maintenance of the cost of living limits the degree of competition in the dyestuff trade to a great extent. The various works still possess valuable assets such as extensive and ever increasing number of patents, sound financial basis and world wide and excellent commercial organizations so that they can look into the future with confidence.

Pharmaceutical Industries — The Swiss pharmaceutical industry comprises not only the manufacture of synthetic drugs but also vegetable and animal organic extracts which are purified and concentrated or converted into compounds of medicinal value.

The expansion of this branch on an industrial scale began in the second half of the 19th century. As a result of the marked advances in therapeutics and pharmacology which took place in the last century, the output of medicinal products from the laboratories of individual pharmacists and apothecaries became insufficient to meet the world's increasing needs. Systematic research in this branch of the chemical industry was taken up to an ever increasing extent by large industrial concerns, resulting in the production of drugs possessing entirely new chemical structures. This was the outcome of many years of research, preparation and trials which naturally could only be carried out by firms possessing a sound financial basis.

The presence of a highly developed dyestuff industry with extensive experience in the manufacture of chemicals, a scientifically trained staff and modern technical equipment, was a fruitful condition for the inception of a pharmaceutical industry in Switzerland. The manufacture of pharmaceutical products developed rapidly, still in close conjunction with the dyestuff industry, and various Swiss dyestuff firms at the present time suc-

cessfully manufacture both classes of chemicals. The manufacture of pharmaceutical products has developed to the greatest extent in Basel, but many firms are situated in Berne, Geneva, Zofingen, Zürich, Nyon and St. Gallen. Special attention was given to the export trade from the very outset.

EXPORT of pharmaceutical products rose from 3.1 million dollars in 1913 to 11.8 million dollars in 1920, but was reduced to half this figure in the following years owing to the decrease in the demand for drugs after the War was ended, and the establishment of competitive firms in other countries. Customs regulations of many of the most important consuming countries have been framed to compel importers to manufacture partly in the foreign country, in particular, making up and packing. This state of affairs prevails to the present day, but in spite of these difficulties the export of Swiss pharmaceutical products is well maintained. Exports have risen since 1922, and were over 9.6 million dollars in 1929, falling during the world industrial crisis to 6.4 million dollars, but managing to reach 8.3 million dollars (14 million dollars at present exchange) in 1935. The export of specialty products enabled the industry to hold its own during the crisis, as the demand for this class of product is more or less independent of economic conditions. The decrease was shown chiefly in alkaloids and every-day products.

Perfumery — The Swiss perfumery industry deserves special notice. This industry has been developed in Geneva and Nyon and also in Dubendorf and Brugg in the neighborhood of Zürich. It covers the extraction of essential oils and the manufacture of synthetic perfumes based on the latest researches in organic chemistry. The perfumery industry has developed on similar lines to the dyestuff and pharmaceutical industry as described previously, and occupied an important position in the Swiss export trade even in pre-War days. Exports in 1913 were valued at 1.2 million dollars, and rose to 2.5 million dollars in 1930, decreasing however, to 1.5 million dollars during the subsequent world crisis. Export conditions have since improved somewhat, and the value of exports for 1935 was 1.8 (currently 3.05) million dollars. The most important markets are France, Germany, United States, England and Southern Europe. Exports to overseas countries have steadily increased in recent years, particularly to South America, the Near East, India and China. In spite of the improvement in export conditions in the last few years, this industry still suffers through heavy import duties. The duty on perfumes is very high, particularly in the best

Principal Swiss Exports, 1929 and 1935

(Millions of dollars, at par prior to U. S. devaluation)

	1929	1935*	Percentage Decrease
Chemical and aluminum products..	44.2	30.0	32.1
Machinery	64.0	28.1	56.2
Watches and clocks	59.2	24.0	59.5
Cotton yarns and fabrics	28.8	13.3	53.8
Silk fabrics and ribbons	35.1	5.8	83.4
Knitted goods	17.1	2.3	86.2

*For comparison, based on 5.18 francs per dollar; 1935 exchange was actually approximately 3.05 francs per dollar.

markets, as perfumes are classed as luxuries and subject to high duties. Doubtless, however, Switzerland will be able to consolidate and improve its position in this branch of organic chemistry in the future.

Electrochemicals—The development of the use of water power in the last 20 years of the previous century made a large supply of electrical power available to industrial concerns. This new source of energy has placed the decomposition and synthesis of inorganic and organic bodies on an entirely new footing. As a result a number of factories were built near the most suitable sources of power on the Jura and Alpine rivers (Schaffhausen, Wallis Valleys, Vallorbe and Turgi) and these were engaged in the manufacture of a large number of products by electrochemical methods. The electrochemical industry made rapid strides in pre-War years, and in the course of a few years, reached a commanding position in the export trade with such products as aluminum, calcium carbide, iron alloys and the products obtained from the electrolysis of alkali chlorides, the perchlorates and the persulphates.

The Swiss aluminum industry was founded in Neuhausen in 1880. This branch of industry made rapid strides and in the course of time important branches were founded in Chippis (Wallis), Lend (Austria) and in Rheinfelden (Germany). The industry occupied the premier place as regards output in this branch of industry on the continent. The United States was the only country which had an aluminum industry on the same scale as that in Switzerland.

The development of this industry was hindered to a certain extent during the War and post-War years by the founding of important competitive firms in the neighboring countries. The Swiss aluminum industry reached its peak in 1928, over 11.5 million dollars' worth of aluminum goods being exported from Switzerland. The value of exports of this class of goods has decreased since 1928, and only reached 2.75 million dollars in 1932, although it rose to 5.6 (currently 9.6) million dollars in 1935. The English customs and fiscal regulations had an adverse effect on Swiss exports while American competition has rendered trade difficult in other markets.

The manufacture of calcium carbide was commenced towards the end of the last century in Neuhausen and in Wallis. This was followed by the manufacture of iron alloys and calcium nitride—the latter an important chemical fertilizer. Considerable quantities of calcium carbide were exported to Germany and the Swiss industry was regarded as one of the most important

in Europe. At the present time a large number of organic compounds such as acetic acid, acetone, etc., are obtained from calcium carbide.

The electrolysis of alkali chlorides was commenced in Monthey and in Chevres towards the end of last century. Turgi and Vallorbe are further important centers for this branch of the chemical trade. The most important products are sodium hypochlorite, chlorine and its derivatives and caustic soda. In addition, large quantities of

chlorates and perchlorates have been prepared. The Swiss chlorate and perchlorate industry is comparable with the persulphate industry inasmuch as both are typical export industries. These industries had an extensive market before the War, and even today do a considerable export trade.

Despite increasing foreign competition the electrochemical industry has been able to adapt itself to the prevailing conditions, and has held its own by the replacement of obsolete processes.

Chemical Engineering Education In Switzerland

By H. E. FIERZ-DAVID

Professor, Federal Technical High School
Zürich, Switzerland*

SWITZERLAND has seven universities and one institute of technology in all of which chemistry is taught as it is the world over. But only at the Technical High School* (Institute of Technology) at Zürich is special emphasis placed on other than simon-pure chemical instruction. The Institute maintains two professorships occupied exclusively with the technical and commercial aspects of chemistry.

During the past 60 years many eminent names have been associated with instruction in pure chemistry in both the Swiss universities and the Institute, including: Wislicenus, Hantzsch, Bamberger, Werner, Willstätter, Nietzki, Kostanecki, Graebe, Staudinger, Viktor Meyer, Kehrman, Pictet, Schönbein, Treadwell and Bistricky. These names are all written in the annals of those who have contributed to the foundations of chemistry. But it is to be noted that only one, Pictet, is Swiss. Hence our chemistry is essentially international and its influence upon technical and commercial aspects about what is evident elsewhere. Furthermore, since perhaps as many as 50 per cent or even more of our students are not Swiss, there is probably no such thing as a "typically Swiss" chemical engineer.

If any difference between our chemical engineers and those of other countries can be discovered, that difference is in all likelihood to be credited to the Institute at Zürich, where the practical point of view as taught by the two professors of chemical technology is indeed in marked contrast to the attitude of

many learned chemists of the "pure chemistry" school.

Georg Lunge was the outstanding figure in our teaching of chemical technology having, in fact, been the founder of this special branch of chemical instruction. His methods were based on the old Bunsen school, with scanty dependence on the so-called physical chemical methods. Hence he was often considered reactionary, but nonetheless he has left behind him the nitrometer which he invented, his "Taschenbuch," and the famous compilations on ammonia, sulphuric acid and tar. His collection of patents in his entire field of teaching has since had important influences.

From still another angle we at the Institute are proud of the products we turn out. After receiving their masters' degrees in chemical engineering, fully 95 per cent of our students go on to other institutions, either in Switzerland or abroad, for an additional 1½ to 3 years, thus earning doctors' degrees. As a rule, then, we feel that our graduates are much more thoroughly trained than those of the universities. The fact would seem to have been recognized throughout Switzerland for most of the leaders in our chemical industry are drawn from former students of the Institute. In fact, at the several chemical works in Basel, the staff includes more "Polytechnikers" among its chemists and chemical engineers than from the seven universities combined. The influence of the Institute has thus made itself so evident that the universities in most cases now teach a certain amount of chemical technology, but not on a compulsory basis, and not, we feel, with the practical slant attained by our own organization.

*The term "Technical High School" is more properly translated Institute of Technology as, in Switzerland, this institution is of university grade.

ITALY

Independence of foreign raw materials and finished products is universally desired today. Evidence of Italy's progress in this regard appears in the following pages



MONTECATINI'S PLACE IN ITALIAN CHEMICAL INDUSTRY

By Dr. Ing. GIACOMO FAUSER

Novara, Italy

NOT LONG AGO Ing. G. Donegani, member of the Italian chamber of deputies, celebrated the 25th anniversary of the chairmanship of the board of the Società Montecatini. For this occasion his collaborators prepared a volume commemorating the tremendous advances made by the company under his leadership.

In order to appreciate this progress, it should be noted that in 1911 the activities of Montecatini were restricted to the exploitation of three pyrite mines and that its capitalization was only 2.3 million dollars. At present, the capital amounts to 64 million dollars and Montecatini controls 43 subsidiaries and affiliates with total resources of 120 million dollars. Its activities embrace the operation of more than 200 plants. During the last 15 years, the writer has been in a position to follow closely the activity of Mr. Donegani and enjoys the privilege of reviewing his outstanding work in this publication. The accomplishment is even more remarkable in view of the great difficulties that had to be overcome on account of unfavorable conditions in regard to raw materials, energy and fuel supplies.

Mining and Metallurgy—Montecatini holds second place in the world as a pro-

ducer of pyrites with nine mines of 750,000 metric tons capacity; 30 per cent of the output is exported. Owing to a limited domestic iron ore supply, the pyrite cinders from the various sulphuric acid plants are collected in the Venezia works, then, after extraction of copper by chlorination, sintered and shipped to blast furnaces for the production of cast iron. At the present time, this procedure is of particular importance to the economic life of the nation.

At present 13 sulphur mines, supplying one of the main raw materials of Italy, are operated by the company. The production amounts to about one-third of the total national output, most of it being prepared in 11 refineries for agricultural purposes.

Lead and zinc mining also falls within the range of operations of this group. The important deposits and installations of Montevecchio in Sardinia have been acquired and modernized. A new plant capable of supplying the entire needs of the country has been erected at Venice for electrolytic extraction of zinc from blende.

Considerable activity has taken place in the field of aluminum. Alumina is produced at Venice, while Mori is the

site of the existing electrolytic plant. A new one is under construction at Bolzano and the combined capacity of both will be 12,000 tons of aluminum, or half the Italian production. The oxide is obtained from bauxite, but its extraction from leucite is being actively investigated because of the large domestic deposits and the possibility of obtaining potash at the same time.

The lignite mines are in full production and drilling is being carried out in the basin of Ribolla for additional deposits.

Owing to the depression in the building industry the marble industry is passing through difficult times. Nevertheless, the Carrara mines, belonging to the Montecatini group, had an output of 39,000 tons in 1935, and increased their exports in spite of the sanctions.

Fertilizers—This is one of the most important industries of Italy from the viewpoint of capital investment and value of its products as well as on account of its importance in the national economy. Only because of the extensive use of fertilizers has it been possible to increase wheat production by 35 per cent in recent years.

Montecatini is operating 57 superphosphate plants with a total capacity of

2 million tons per year or 80 per cent of the domestic production. It has further initiated a well-developed synthetic ammonia industry using electrolytic hydrogen, thus liberating the country from dependence on nitrogen imports and safeguarding the nitric acid supply necessary for national defense. The plants at Novara, Merano, Crotone, Bussi and Mas have a total capacity of 80,000 tons of ammonia per year; a new installation, rated at 35,000 tons of ammonia, is under construction at San Giuseppe (near Savona), using coke-oven gas for its hydrogen source. Ammonium sulphate is the chief product, while a considerable part of the ammonia is converted into concentrated nitric acid, nitrate of lime and ammonium nitrate and phosphate.

Montecatini holds a large interest in the Société Ammoniaque Synthétique et Dérivés and the Compagnie Neerlandaise de l'Azote operating the works at Willebroeck, Belgium, and Sluiskil, Holland.

Finally, the plants at Domodossola and St. Marcel produce about 25 per cent of the Italian output in cyanamide, the installations having a capacity of 30,000 tons of carbide and 55,000 tons of cyanamide.

Chemicals—Montecatini has an output capacity of 1 million tons of sulphuric acid, equal to 70 per cent of the Italian production. Chamber acid is produced in 60 installations, while five are using the contact process.

With a yearly output of 100,000 tons of copper sulphate in seven plants, the group leads the world in production of this commodity. Three plants are producing electrolytic caustic soda and chlorine, and five hydrochloric acid.

Methyl alcohol is synthesized at Merano and three more installations are under consideration. Part of the alcohol is transformed into formaldehyde, which is gaining in importance for the production of high explosives. Other products include arsenates, barium and magnesia salts, carbon disulphide, bichromates, synthetic camphor, sodium, cyanides, and so on.

A large plant at Milan manufactures 2,000 tons of titanium white per year, and even larger works have just started operation at Livorno for the production of lithopone. The factory at Avigliana is making nitrocellulose-base lacquers and phthalic anhydride-glycerol resins.

The production of plastics by condensation of formaldehyde with urea has been perfected recently. Urea is synthesized at Novara and another installation of 5 tons daily capacity is under construction at San Giuseppe.

Explosives—Montecatini is able to supply all of the types of products required for national defense with its ten plants. Recently, the large scale production of trimethylenetrinitramine (T4), a powerful explosive, has been achieved starting from formaldehyde and concentrated nitric acid.

Rayon—A subsidiary, the Società Rodiacetà, is producing acetate rayon at Pallanza. Owing to its high quality, this material met with immediate success on the Italian market. The works at Villadossola supply acetic acid and other materials necessary for this plant.

Dyes—While Cengio produces the intermediates such as nitro-derivatives, aniline and phthalic anhydride, the Cesano plant turns out the entire series of organic colors as well as other chemicals. Owing to well-developed tech-

nique and organization, successful competition was maintained with imported materials and the 1935 production was double that of the preceding year.

Pharmaceuticals and Perfumes—Italian imports of these materials amount to about 8 million dollars annually. Hence, the company has entered this field with its plant at Settimo Torinese after technical collaboration with the French concern, Rhone-Poulenc. Synthetic essential oils and photographic chemicals are to be added later on.

Hydrogenation—Recently, Montecatini organized the Azienda Nazionale Idrogenazione Combustibili with a capital of 32 million dollars subscribed to 50 per cent by the government. The new concern is to manufacture synthetic motor fuels. Two large plants will be erected at Bari and Livorno. Crude oil from the Italian concession in Albania and lignites from Toscana will be hydrogenated. An output of 300,000 tons of liquid fuel per year is anticipated.

Electric Energy—The group is using 1,500 million kw.-hr. per year, equal to over 10 per cent of the Italian output. Of this amount 40 per cent is generated in seven fully owned hydroelectric power plants.

Research—Montecatini maintains two modern research laboratories provided with the latest equipment; that at Cesano is devoted to organic chemistry, at Novara, to inorganics.

To complete the picture of this many-sided concern, in addition it possesses eight plants for producing glue and gelatine, one for lubricants and four jute mills; to these should be added a metallurgical plant, a foundry, a coke plant, and in addition, a railroad and a navigation company.



Above: Montecatini's synthetic ammonia plant at Sinigo, near Merano



Below: View in cell room of Montecatini's Mori works, Trentino, where aluminum is produced

Self-Sufficiency Is Goal of Italian Chemical Industry

By RAFFAELE SANSONE

Genoa, Italy

DURING recent years the Italian chemical industry has been greatly consolidated through numerous mergers. At the same time, new products have been developed successfully, and some branches of the industry have increased output considerably. A large proportion of former imports has been replaced by domestic products manufactured from domestic raw materials.

Activities have increased in several branches of Italian industry neglected until the situation at the end of 1935 opened new opportunities. The production of substitutes has increased; more plants have been erected for the hydrogenation of lignites, mineral and vegetable oils. Alcohol has become increasingly important as a motor fuel, both as an admixture with gasoline as well as an exclusive fuel. At the same time, the higher alcohols have been made in sufficient quantities to take the place of imports. Marsh gas is being utilized in compressed and liquid form as fuel for motor cars, trucks and railroad vehicles. New laws have forced the gas plants and other coal distillers to increase greatly the production of benzol. A large petroleum refinery is under construction. The well developed fertilizer industry has augmented the output of superphosphate, nitrates, ammonium salts, etc., on account of increased consumption following the government's policy of raising more farm products. The explosives industry has maintained a high production level in supplying the army and navy, local raw materials having replaced to some extent those formerly imported which fell under export embargoes of other countries.

The gas plants, despite difficulties in securing high quality coal in sufficient quantities, have managed to maintain gas deliveries as to quality and quantity at or near the previous levels: local lignites and coal are being used successfully in different parts of the country. Distillation of various fuels, shale and asphalt rock has been under investigation. Natural gas from the oil wells in Tuscany is being utilized, partly for the production of electrical energy. In general, it may be said that if sufficient capital is invested for the exploitation of our sub-soil, Italy can in all probability become self-sufficient in both petroleum and coal.

A new concern, the Società Italiana dello Zinco, erected a plant at Marghera

(Venice) for electrolytic treatment of zinc minerals, the roaster gases being used for sulphuric acid. The Società Ammonio e Derivati, a subsidiary of the Montecatini group, with plants at Sinigo, Crotone and Novara, produced 340,000 tons of ammonia products in 1934 at the Crotone plant alone. Production of diammonium phosphate was increased.

The necessity of reducing costs of production induced Montecatini to construct a large ammonia plant at San Giuseppe di Cairo (Savona) using hydrogen from coke-oven gas. The coke plant has a daily capacity of 1,000 tons. Part of the gas is used for the production of electric energy. The plant is rated at 14,000 tons of nitrogen per year. Recently, Montecatini perfected the production of artificial cryolite and synthetic camphor, supplying domestic needs and leaving an export surplus.

Glue and gelatine production has been modernized, that of mineral colors has made notable progress also. At Leghorn, new installations have been erected for the production of lithopone, the output being sufficient to permit some export.

Production of chemicals and allied products, since the advent of the corporate legislation, has been supervised by a considerable number of committees. Recently certain of these committees have initiated extensive research looking toward the further self-dependence of Italy. Among the projects have been those dealing with increasing the output of distillation industries, recovery of mineral oil from asphalt rock, development of lubricants containing mineral, animal and vegetable oils, and the further exploitation of domestic fuel sources.

The electrochemical industry made great progress last year and found a ready market for a production increased by 20 per cent over 1935. The Società Elettrica ed Elettrochimica del Caffaro, Milan, merged with a hydroelectric power company. Its products comprise polychloronaphthalenes (artificial waxes), chlorinated india rubber and potassium permanganate. A new plant has been designed and erected in Denmark for the Dansk Sojakagefabrik, Copenhagen, licensee for the "Siclor" patents, a process for a special kind of hypochlorite of calcium.

Rayon production rose to 86,000,000 lb. in 1935 and that of staple fiber more than tripled to 77,000,000 lb. Of this production 46,000,000 and 26,000,000 lb. respectively was exported. During 1935 the Snia Viscosa of Milan was probably the largest rayon producer in the world. The company is completing a large new plant designed primarily for staple. This is expected to increase the Snia capacity to four times that of 1930 and to contribute largely to Italian textile independence.

During 1935, large scale exploitation of the "Ferretti" patents on synthetic wool from casein (Lanital) was carried out successfully. The new product has proved satisfactory in every respect and is spun, woven and dyed under the same conditions as natural wool.

The tartaric acid industry suffered from the disturbed international situation as it is primarily an export industry. The principal producer, the Società Anonima L'Appula enlarged its scope of operation, winning a prize for producing potassium carbonates and hydrates from distillery wastes. Special mention should be made of the installation for molten potassium hydrate; its capacity is 3,600 tons of potassium derivatives per year of which 1,000 tons is fused caustic potash.

When sanctions were instituted against Italy, the sugar industry had stocks of over 300,000 tons of sugar, sufficient to last until the 1936 campaign besides providing a reserve of about 100,000 tons. This surplus is to be transformed into alcohol fuel. For the coming campaign, beet production will be increased, assuring every refinery of full operation. Total capacity is over 60,000 tons of beets per 24 hours, equal to about 7,000 tons of sugar. The distillers have an output of over 200,000 gal. per day of fuel alcohol which is extracted from beets, molasses and other raw materials. Arrangements also have been made to cover domestically the full demand for beet seeds that had to be imported in former years.

In general a large number of permits have been issued for the construction of new chemical plants, the Government deciding in each case on the desirability of the project and its non-interference with the prosperity of existing enterprises.

Fortunately, chemistry is being given more attention now than ever before. Italian research, as well as contact with developments in other countries, assist in keeping our industry in the forefront. With a considerable increase in the number of chemical engineers, Italian laboratories and plants are now fully able to equal the accomplishments of those in any other country.

CHEMICAL ENGINEERING AND INDUSTRY IN

RUSSIA



By E. Sviatlovski

Director of the Mendelejeff Centrographical Laboratory, Leningrad.

Left — E. Sviatlovski, director of Mendelejeff Centrographical Laboratory. Right — M. Mladenjeff, director of Mendelejeff Museum in Leningrad

SOVIET chemical industry has been built on a triple foundation of natural resources, fundamental science and, most important, an energetic human contribution. So much has already been published in your journal and elsewhere regarding the recent achievements in the utilization of Russian resources (See *Chem. & Met.* Dec., 1929, p. 724; also articles by Alcan Hirsch, Nov. 1932, pp. 590-4 and by E. Sviatlovski, Sept., 1934, pp. 468-9) that the present discussion will be confined largely to scientific and professional developments in chemical engineering and industry.

We have in the Soviet Union an expression: "A qualified personnel decides everything." Certainly an important feature in the new epoch in Soviet industry has been the ready adaptation of our people to new industrial conditions. The difficulties in this connection were evident from the beginning to those who outlined the second five-year plan. They said: "We must enroll in the process of industrial production many millions of men who must be taken out of rural life entirely unacquainted with plants and machinery. We estimate that by the end of 1937 more than eighteen millions of such men must be employed in our industries. But this mass of men will be served by the most modern equipment available for continuous processes of production." When this technical propaganda was broadcast in all directions, it had the immediate effect of stimulat-

ing technical study among large masses of the laboring class. A very high percentage of the younger generation was attracted with the results that the Soviet colleges and universities numbered in their enrollments in October 1935 approximately 520,000 students as compared with 190,000 in 1930. During this period the number of industrial colleges and the higher technical schools had increased from 29 to 122.

The Engineering-Technical Association undertook the task of stimulating scientific research and education through consultation and assistance to the higher schools and the technical press. In the spread of technical information, the part played by the Central Institute of Technical Information with its bulletin of "Technical News," its card indexes, world patent abstracts and references, proved extremely important.

Many unfamiliar with the Stakhanov movement may not realize the extent to which it has penetrated into the technology as well as the production phases of chemical industry. Publicity has been given to such achievements as the work of a day-shift in a contact sulphuric acid plant that increased its output by as much as 250 per cent.

Thus the Stakhanov movement has proved an impulse for chemical engineering research and plant studies with a view to greatly improving the average performance of our chemical plants.

Stalin has said "What is science for if not to cut the connection between experiment and practice?" When one reads the report of the various scientific institutes of the U.S.S.R., it becomes apparent that great progress is being made in that direction. The second five-year plan of the Academy of Sciences provides for a vast program of problems connected not only with the science but with the application of chemistry in industry. A chemical engineering section of the Engineering Technical Council of the Academy was organized in 1935 (Acad. Britzke). Among the other important institute and scientific groups that maintain close connection with the Academy are the following:

1. Institute of Economic Mineralogy (Moscow) has forwarded the development of new industries in utilizing non-metallic minerals such as mica, graphite, cryolite, kaolin, arsenic and talc. It has also stimulated the study of rare elements and their utilization.
2. Institute of Applied Chemistry has been concerned with synthetic rubber, alumina, cyanide, phosphoric acid, chlorine and similar electrochemical and metallurgical products.
3. Institute of Chemical Physics aims to advance the application of the theories and methods of modern physics in the chemical field.
4. Karpov Physical and Chemical Institute (Moscow Acad. Bach) is concerned with chemical kinetics, biological chemistry, catalysis, new raw materials for plastics and safety glass.
5. Institute of Fertilizers and Insecto-fungicides has developed many new processes of production, among them electro-thermic and wet methods for phosphoric acid, ammonium phosphate, double and triple superphosphate. In its "Transactions," this Institute has published more than 3500 papers having to do with the production and use of fertilizers.
6. The Institute of Nitrogen, among various phases of its work, has studied the electrolysis of water for hydrogen produc-

tion, problems in the transport of liquid ammonia, the deterioration of ammonium nitrate and has developed the Soviet catalyst for ammonia synthesis.

7. The Institute of Plastics worked out and introduced into practice a number of processes for the production of cellulose ether and new products of polymerization and condensation. The work of this institute as well as other Soviet research organizations is cited in "Chemical Abstracts" (U.S.A.).

8. Institute of High Pressure. Working in the plant of the Nitrogen Combine of Gorlovka, this Institute has developed a

filtration especially in connection with the rotary vacuum filter, the automatic centrifuge, development and classification of chemical engineering equipment, wood as a material of construction, welding, especially of high chrome alloys, etc.

Foreign readers may perhaps also be interested in knowing that the Moscow edition of Professor MacBain's "The Sorption of Gases and Vapors by Solids" has sold many times more copies to Soviet citizens than the entire number of English copies which exist in all countries of the world taken together. A Russian translation of the well-known Perry's "Chemical Engineer's Handbook" is already in print in three volumes with supplements for Soviet readers.* Our engineers believe that the freest international exchange of ideas and achievements is of great benefit.

Industrial Reconstruction

In order to complete the program of construction and reconstruction of chemical industry of the U.S.S.R., the second five-year plan (1932-7), stipulated the following:

To master and install the newest and most advanced processes (such as electrochemical, electrothermal methods, contact systems for the manufacture of sulphuric acid, the use of biochemical processes and reactions in gaseous phase), to develop a combination of chemical industry with the metallurgy of ferrous and non-ferrous metals, with coke production and petroleum refining, to develop the production of fertilizers (tenfold) by changing to the more concentrated double superphosphates, am-

monium phosphates, etc., to develop new processes and products of fuel technology, organic synthesis of dyes, plastics, solvents, lacquers, to develop the production of synthetic rubber, of wood alcohol, etc., calls for the closest linking up of the work in basic chemical industry with the latest in science and technology.

The eastern trend of chemical industry in U.S.S.R. is shown in the maps recently prepared by this author. The center of our chemical industry during the first five-year plan has moved eastward in terms of longitude by about 10 deg. when compared to the status in the years 1927-8. The size of this movement contrasts to the 11 deg. of total westward movement of the center of population in the United States in the period 1790 to 1930.

In 1930 practically the only modern chemical plant in the U.S.S.R. was the nitrate fertilizer plant at Chernorechye. Since that time three more have been built at Berezniki, Stalino-gorsk and Gorlovka. New sulphuric acid plants have increased the annual output capacity from 375,000 tons to 968,000 tons and production in 1934 was 708,000 tons against 356,000 in 1930. The huge Yaroslavl rubber combines have been placed in operation and three synthetic rubber plants, newly built, made 11,000 tons of rubber in 1934; a fourth is being built in Armenia. Three billion rubles have been invested in this industry and the value of the output of all branches has risen from 968 million rubles in 1930 to 1,372 million in 1934.

Some idea of the extent of present construction and reconstruction may be gaged from the following table:

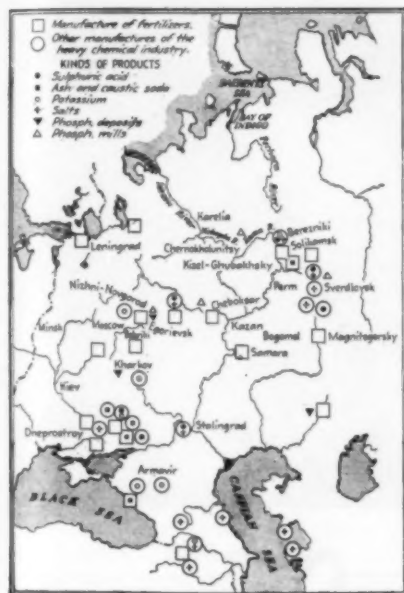
new process for the manufacture of the catalyst used for ammonia synthesis.

9. Institute of Aluminum contributed greatly to the development of the great aluminum industry (Volkhov, Dnieper, Tikhvin and Ural Combines).

10. Institute for the Organization and Safeguarding of Labor has been concerned with matters of safety, plant hazards, industrial hygiene and sanitation.

The immense growth of chemical industry and chemical engineering has stimulated a rapid development of periodicals and published literature dealing with chemistry and chemical engineering. The names of some of our periodicals on research and scientific subjects will be found in *Chemical Abstracts* No. 22, Nov. 20, 1935, pp. 7,701-7 and 7,778. Chemical engineers will be particularly interested in a special journal on "Chemical Mechanical Engineering" which has now reached five volumes. During the past year it has presented a series of interesting papers dealing with evaporation and heat transfer, the thermodynamics of the drying processes,

*Editor's Note:—This is news to us. Neither editor nor publisher has authorized such a translation of copyrighted material.



Chemical Industries	Countries that are behind the U.S.S.R. in relation to volume of output ¹		Countries that will still exceed U.S.S.R. after 2nd five-year plan
	During first five-year plan ending 1932	During second five-year plan ending 1937	
Ammonium Sulphate...	Austria, Canada, Spain	Czechoslovakia, Holland, Poland, Italy, France, Japan, Belgium, England, U.S.A.	Germany
Sulphuric Acid.....	Poland, Spain, Portugal	Belgium, Italy, France, England, Germany	U.S.A.
Superphosphate.....	Portugal, Poland, Belgium, England	Spain, Japan, Australia, France	U.S.A.

¹The output in the case of all foreign countries is taken as that reported for 1929.

Electrolytic cell room in the Dnieper aluminum plant

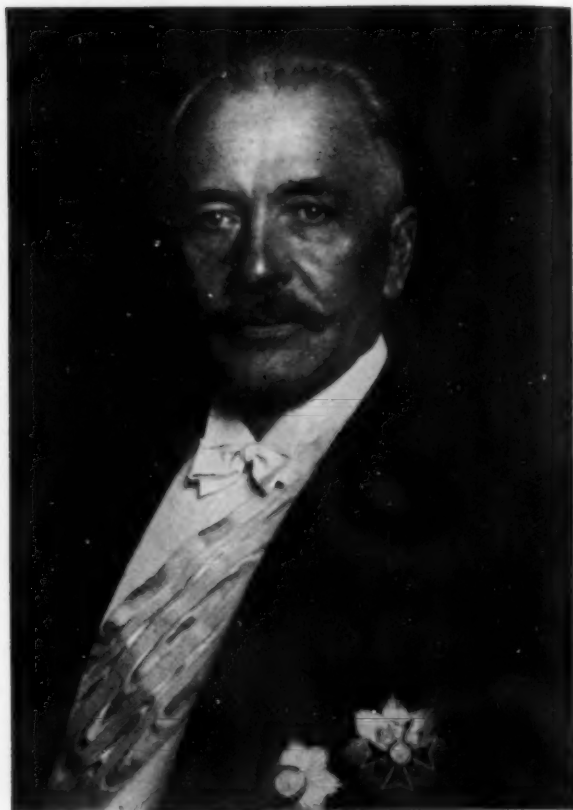


A MESSAGE FROM

THE PRESIDENT OF
POLAND

By **PROF. IGNACY MOSCICKI**

*President of the Republic of
Poland*



NOTHING is more characteristic of the development of the civilization and economic life of a country than the extent of the output and the variety of the consumption of products manufactured by the chemical industry.

The history of this industry is most instructive. Toward the end of the 19th century, a chemical industry was regarded as being on a large scale if it manufactured several hundreds or perhaps thousands of pounds of dyestuffs or other products of organic synthesis. Today the macro-chemical industry, manufacturing products of general utility, treats hundreds of thousands and millions of tons of various kinds of raw materials, including atmospheric nitrogen. In many cases the construction of the apparatus itself meets with difficulties which are greater than those encountered in any other industry. Chemical engineers have had and still have the task of inventing the most suitable devices for handling great masses of raw materials

at high temperatures or under high pressures.

The progress of the chemical industry has also contributed to the enormous development of various energetic educational institutions. For these reasons every country, and Poland, of course, too, is making great efforts to develop its chemical industry and to provide the best instruction and training for chemical engineers. Concurrently with the powerful development of the macro-chemical industry, treating enormous quantities of raw materials, progress is being made in a new branch of synthesis of complicated chemical compounds which requires exceptionally subtle knowledge and a thorough theoretical background.

In effect the chemical synthesis of complex organic substances such as the vitamins and hormones, those marvelous biological micro-factors, is no longer a problem exclusively occupying the minds of theoretical chemists. On the contrary, it has already become a

technical problem, initiating a new line of endeavor, which in view of the quantity of substances prepared and consumed, may well be called the micro-chemical industry.

This field of work opens to humanity new and vast horizons which the mind of contemporary man is still unable to grasp.

The present state of pure and applied chemistry is the outcome of the work of barely five or six generations. No one can foresee what is yet to come. But the fact that such important results have been attained in such a short time is a powerful impulse spurring on to fresh labor and new successes. It is here that we can witness the strength and the great power of the creative spirit of humanity.

The chemists and chemical engineers of Poland together with those of other countries are imbued with the fullest enthusiasm for the work which will in so great a measure influence the future development of mankind.

Czechoslovakia Shows Notable Chemical Development

From a Paper* by
Ing. Dr. JAN MECIR
*Director of Explosia
Semtín Near Pardubice
Czechoslovakia*

FOLLOWING the War, fundamental changes have taken place in Central Europe. The new political order affected the economic life of Czechoslovakia especially, because most of the industry of the old Austrian-Hungarian Empire was located within what is now this territory. Complete re-orientation was imperative; new products and industries had to be taken up and others reduced to the actual needs of the new State and its export possibilities. Chemical industry, established only in certain branches, found an opportunity for notable developments under these conditions.

Leading in the chemical field is the well known Society for Chemical & Metallurgical Products at Aussig a. d. Elbe, a thoroughly integrated concern producing heavy chemicals, acids, oleum, phosphates, synthetic nitrogen, cyanamide, fertilizers, mineral colors, pigments, dyes, and so on.

The Mining & Industrial Establishments, formerly Jan David Starck, near Pilsen, is manufacturing mineral salts, oxides, alumina derivatives, hydrofluoric and other acids, phosphates, and so on.

The Company for the Production of Fertilizers and Chemicals, at Kolin, is producing fertilizers, heavy and organic chemicals, as well as radium and its preparations through a subsidiary.

The Society Dynamite Nobel, Pressburg, had to reorganize its works completely; a subsidiary, Explosia, located at Semtín near Pardubice, erected new plants for explosives, nitrocellulose lacquers and so on. Other products of this concern are heavy chemicals, acids, and especially sulphur chloride and carbon bisulphide.

Synthesia, Chemical Industries, at Semtín, was founded after the War and produces synthetic nitrogen, oleum, soda, phosphates, nitric acid and fertilizers.

The largest producer of nitrogen products is the Works for Nitrogen Products, Moravska Ostrava, producing synthetic nitrogen, nitric acid and combined fertilizers. Another important concern in the fertilizer line is the First Moravian Agricultural Plant, Prerov.

Other chemical concerns are: Hardmuth (graphite, Kohinor pencils); a large producer of carborundum at Staré Benátky exporting most of its output; the Solvay works at Nestemice; Ossa, at Prague (glue and gelatin); Schicht (soap and glycerine); and Dr. Heisler, at Fragner (pharmaceuticals).

Wood distillation is of great importance to the eastern districts of the country. Two large concerns are active in the production of rayon, while plastics are manufactured by a number of companies as well as rubber goods, photochemicals and metallic salts. Bata, the well known shoe concern, is also active in chemicals, manufacturing for its own use.

It is obvious in view of the far-reaching reorganization of Czechoslovakian chemical industry that numerous arrangements had to be made for using

the best foreign methods and rationalizing operations as far as possible. The highly developed domestic steel industry—we might mention the Poldi Works—supplied the necessary material.

Locally developed processes include: the production of sodium nitride from products of oxidation of ammonia (by Synthesia); making of chalk saltpeter and the use of nitric acid for the decomposition of phosphates (by Nitrogen Products); preparing nitrocellulose for the varnish industry by a continuous process, suitable also for small capacity (Valouch and Korda process adopted by Explosia); and the large scale production in one phase of pure trinitrophenol (by Explosia) and others.

Great progress has been made in safety explosives for mining, as well as in the production of insecticides and pharmaceuticals. The latter necessitated completely new development, resulting also in the invention of the novel colloid mill of Oderberger.

An interesting note might be added in regard to alcohol, 70 per cent of which is produced in small agricultural distilleries. In view of the large output, a 20 per cent admixture to motor fuel is compulsory, thus disposing of over 60 per cent of the alcohol production.

Compared with conditions before the War, the chemical industry of Czechoslovakia is today in healthy condition, fully justifying all expectations.

Industry Realigns in Belgium For Home Consumption

Based on Communications From

A. GILLET

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ORIGINALLY the chemical industry of Belgium exploited the resources of the country, thus limiting itself to coal, iron, cement, glass and zinc. Within the last generation however, this situation had been completely reversed, for raw materials have been imported and with the assistance of a plentiful supply of coal and skilled labor transformed into exportable products. During the last decade, further development has taken place in that even coal is imported in large quantities, the Belgian deposits (anthracite) not being suitable for coke-ovens or for the use of the modern extraction technique.

Although there are numerous smaller concerns in the Belgian chemical industry, a considerable part of the business

is in the hands of three large groups including: Société Belge de l'Azote (S.B.A.), at Ougrée-Marihaye; Union Chimique Belge (U.C.B.); and Etablissements Kuhlmann. Solvay & Cie., although of Belgian origin, has had more extensive development abroad than at home.

New industries have been initiated in Belgium from time to time, including soda, radium extraction, rayon and rubber goods manufacture. More recently the production of chemicals has been extended to zinc oxide, lithopone, dyes, sulphates, phosphates, silicates, borates, chlorine derivatives, explosives for the mining industry, copper refining, and so on, drawing raw materials from abroad and especially the Congo Colony. A

*Excerpts from the author's paper presented before the 14th Congress of Industrial Chemistry, Paris, Oct., 1934.

Selected Items of Belgian Industrial Production and Exports

(Units are in thousands of metric tons)

	Production		Export Balance	
	1929	1933 (or 1934)	1929	1933
Plate glass.....	530,000*	22,000*	285	107
Cement.....	3,680	2,260	1,908	724
Solvay soda.....	80	70	—140	—62
Rayon.....	7.3	4.2	2.5	2.6
Photographic materials.....			2.8	1.5
Explosives.....			2.8	1.3
Sulphuric acid.....	830	1,000	228	
Superphosphates.....	380	250		
Sulphates.....	195	410		
Ammonium sulphate.....	150	100	58	
All fertilizers.....			1,600	1,500

*Square feet.

primary characteristic of all Belgian industry is its export orientation.

It is interesting to note that recently the last city gas works was closed, gas production and delivery having been taken over by large coke plants supplying the country over a long distance network. Similarly, all of the more important electric power plants are inter-connected irrespective of whether they are publicly or privately owned. Almost half of the coke oven gas generated is used for heating the ovens, the other half being subject to further treatment. Hydrogen produced at the coke plants has given rise to important synthetic nitrogen and fertilizer producing units which today have an installed capacity amounting to 200,000 metric tons of nitrogen per year. Two plants are now producing sodium nitrate direct from salt and nitric acid. Only one plant falls in the electrochemical group and this produced 3,000 tons of carbide and 15,000 tons of cyanamide in 1935. Production of fine and photo chemicals, pharmaceuticals and organics generally is increasing rapidly. Fully 50 per cent of the world supply of citric acid originates at Tirlemont where it is produced by fermentation. A Belgian process of hydrogenation is producing 10 tons of liquid fuel daily.

The worldwide depression of recent years marked the end of the period of expansion for the Belgian industry. Owing to its dependence on exports, the country has been hit especially hard, and its industries will have to be reorientated. Assisted by trade restrictions and tariffs, new products are now being manufactured and more attention is being paid to the domestic market. Other factors working in this direction are trade agreements between and mergers among the companies which have become frequent of late in an effort to protect mutual interests.

Belgian chemical engineering has had many notable achievements to its credit: Solvay and Chardonnet were respectively pioneers in soda and rayon manufacture. The Fourcault process for plate glass production, a Belgian development, has gained worldwide importance. Even at present there is considerable industrial research activity going on in other fields such as cement, sugar and coal (the last

looking toward a wider utilization of Belgian deposits).

Until 1929, the title of "chemical engineer" was not legally protected, nor was there any specialized course provided by the universities. Both Belgian engineers and Belgian industry previously were

more concerned with exploitation and administration than invention, and a general engineering education was felt to be adequate. But today conditions have changed, and it is not unlikely that we shall have a "new deal" in the field of education as well as in industry.



Above: Contact sulphuric acid plant of Chemische Fabrik Wagenmann, Seybel & Co. A.G., at Liesing, Austria

Right: Hydrochloric acid and salt cake installation of Pulverfabrik Skodawerke-Wetzler A.G., at Moosbierbaum, Austria



Austrian Chemical Industry a Post-War Development

By Ing. Chem. J. POLLAK
Pulverfabrik Skodawerke-Wetzler A.G.
Vienna, Austria

AFTER the peace treaty of St. Germain, what remained of Austria did not have within its boundaries a chemical industry that could supply the needs of the country, for nearly all the chemical plants of the old empire were located in the successor States. Within the new Austria there remained only two large explosives plants, which were dismantled as required by the Peace Treaty, and a soda industry of high efficiency. The Pulverfabrik Skodawerke-Wetzler A.G. changed over its large explosives plant in Moosbierbaum for the production of heavy chemicals.

The first step undertaken was the construction of a large chamber sulphuric acid plant with a yearly capacity of 30,000 metric tons, followed by a plant for 40,000 tons of superphosphate. Then, plants were built for the production of sulphates and hydrochloric acid, chrome alum, aluminum sulphate, potassium nitrate, zinc chloride, potato starch, dextrine and glucose.

These products having become well established, the manufacture of bleaching clay was taken up. Originally it had been intended to use Bavarian clay, but last year a suitable base was found in Austria, making this production independent of foreign raw material.

Finally, a second chamber sulphuric acid plant was erected, having a capacity of 18,000 tons of chamber acid per year.

After the War there were two plants in Austria producing sulphuric acid by the Mannheim contact process; one was connected with the government explosives works at Blumau, the other with Chemische Fabrik Wagenmann, Seybel & Co. A.G. at Liesing. When this concern was merged with the Skodawerke-Wetzler A.G., the sulphuric acid plant was rebuilt, incorporating the latest improvements, and the Blumau installation closed.

In cooperation with the government, the Pulverfabrik Skodawerke-Wetzler

A.G. organized the Sprengstoffwerke Blumau A.G. The old explosives works of the government was liquidated and a new, much smaller plant erected, conforming to the Peace Treaty and to the needs of the present State. It produces dynamite and safety explosives as well as trinitrotoluol, nitrocellulose and other explosives.

Recently, a plant for the production of phosphoric acid and its derivatives has been put in operation at Mossbierbaum.

Other installations made since the War include the following: The Oesterreichische Kunstdünger-und Chemische Fabrik A.G. has rebuilt the fertilizer plant at Deutsch-Wagram. This plant, which had been idle for some time, now belongs to the Oesterreichische Dynamit Nobel A.G.

The official administration of the salt works erected an installation for the electrolysis of alkaline chlorides at Hallein (Salzburg). This plant has been taken over by the Solvay Co. which operates a soda plant at Ebensee (Ober-Oesterreich).

The rayon factory at St. Pölten has been reconstructed and after a temporary shut-down, now produces about 1,000 tons of viscose per year.

The Bleiberger Bergwerksunion in Carinthia built a plant for the production of lithopone that has started operation successfully.

The Chemische Fabrik Wagenmann, Seybel & Co. A.G. has modernized its obsolete installations, incorporating all the latest developments for making such products as fuming sulphuric acid, chamber acid, copper and aluminum sulphate, sodium sulphite, bisulphite and thiosulphate, potassium ferri- and ferrocyanide, hydrochloric acid, and so on.

The Vereinigte Chemische Fabriken Kreidl, Heller & Co. has enlarged its line considerably and achieved notable success with products for crop protection. The plant producing saccharine, located in Ober-Oesterreich, is now affiliated with this concern.

The Continentale Gesellschaft für Angewandte Elektrizität at Landeck (Tirol), a subsidiary of the Oesterreichische Dynamit Nobel A.G., has hydroelectric power of about 50 million kw.-hr. per year for the production of calcium carbide (capacity 8,000 tons yearly) and ferro-silicon with 10-75 per cent silicon. The same concern owns the Karbidwerke Deutsch-Matrei A.G. at Brückl (Carinthia) with installations for electrolysis of alkaline chlorides (4,000 tons NaOH and 1,000 tons KOH per year), chlorine, calcium hypochlorite, potassium chlorate (KClO_3) and chloride, mercuric chloride, trichlorethylene and carbon tetrachloride.

Great progress has been achieved in

pharmaceuticals, especially in organic products. The makers of varnishes and mineral colors have modernized their facilities and have recently marketed products that have been of specially high quality.

This short outline is an indication of

the difficulties which have beset the young chemical industry in post-War Austria. From modest beginnings the industry has now attained a position which it has been able to maintain despite all the economic adversities of recent years.

Export Restrictions Are Forcing Diversification in Holland

SPECIAL CORRESPONDENCE

CHEMICAL INDUSTRY in Holland was organized essentially for export and, in former years, obtained an important share of the world's trade. However, it has become necessary to rely more and more on the home market alone on account of increasing import restrictions abroad, tending to make other countries self-dependent and to encourage local manufacturing of new products. This development has initiated efforts toward production of a wider range of products to supply the Dutch domestic demand.

The coal mines of Holland provide the raw material for the entire series of coal tar products. Of a total coal production of 12 million tons, the government-owned mines at Limburg supply 7 million. At the same time the government coke plant—the only one in the country—has a capacity of 2.3 million tons of coke per year. Its by-products include benzene, toluene, xylene, solvent naphtha and sulphate of ammonia as well as tar for wood preservation and road construction, anthracene oils for crop protection,

crude anthracene and naphthalene, and pitch.

In order to take full advantage of the coke-oven gas supply, 2,000 million cubic feet yearly are distributed through an extensive network, the rest being used mainly as a source of hydrogen for the largest ammonia plant of the country with a capacity of 60,000 tons of N_2 per year. In addition to ammonia this producer manufactures sulphate of ammonia, nitro-chalk containing 20.5 per cent N_2 ($\text{NH}_4\text{NO}_3 + \text{CaCO}_3$), nitric acid and sulphuric acids (98 per cent and weaker).

Brine is available in large quantities, supplying the caustic soda, chlorine and bleach industries. Other raw materials are furnished by agriculture and cattle raising. The output of the soap industry is more than adequate for the domestic market; the same is the case in regard to oil refining.

Moreover, raw materials and minerals can all be supplied from the colonies; in other words, Holland will be able to produce all necessary chemicals within its boundaries should the complete loss of export markets force this development to be carried out by her industries.

Based on information supplied to us by Prof. F. K. van Iterson of Limburg, and Dr. J. Akkerman of The Hague, Holland.

Nitrogen fixation plant owned and operated by the Government coal mines of the Netherlands at Limburg, Holland



Japanese Chemical Manufacturers Becoming Large Exporters

By J. E. BUDD
Tokyo, Japan

IN PROPORTION to the total export volume of business, the rate of development of the chemical industry in Japan has been higher this year than ever before. Moreover, Japan has succeeded in checking imports and in making an almost complete about-face, for the first time finding herself exporting chemical apparatus, sulphate of ammonia, caustic soda, synthetic dyes, and other high class chemicals, rather than importing them in such large quantities as formerly. In fact the exports of chemical goods have shown, this year, a marked increase over those of fiber goods.

The Japanese give some of the following reasons for the remarkable rise of this industry. The demand for aluminum for military purposes has stimulated research with the result that it has been found that alunite, which is produced in large quantities near Moppe, Chosen (Korea), can be made into alumina and used as raw material for aluminum. A new Korean plant with ample electric power is soon to be completed for the Korean Nitrogen Fertilizer Co., an affiliate of the Japan Nitrogen Fertilizer Co., of Osaka. This concern has decided to start aluminum refining in the spring, co-operating with the Japan Magnesium Reduction Co., another affiliate. Whether new companies will be created or whether Korean Nitrogen will simply erect new factories has not been decided. But, since last spring, Korean Nitrogen has been experimenting and now feels confident that it can achieve a commercial success at aluminum refining.

In Korea the concern has the advantage of a liberal supply of electricity, as well as local raw material for the making of alumina. The ore is pulverized by electric power and then a dry system used. Recently, the Government has submitted a bill for the protection of the aluminum industry, in order to oust imports from this market. On the other hand, this raises an interesting question of just what action the International Cartel will take if the import duties are raised by the Japanese without international consent.

Also, it should be mentioned that in Manchoukuo a method has lately been developed for making alumina from a certain kind of clay found there. Japan

has put a distinctly Japanese touch to aluminum finishing in the recent discovery of what is called the "alumite" process. The finish, which results from applying oxalic acid to aluminum, is particularly saleable in Japan for the reason that the Japanese have previously been lacquering aluminum.

Manufacture of metallic magnesium has also been making rapid headway in Japan. It is used in alloys for high grade machinery such as airplanes, telescopes, cameras and movie apparatus. Japan is now producing sufficient brine and magnesite to yield large quantities of magnesium although her annual output is still less than 200 tons as compared with the world production of 5,000 tons. But she has hopes of still further increasing her output by reducing the price of the metal, feeling that she can never really make a great success of this product until its cost of production can be brought down near to that of iron. Considering that the specific gravity of iron is about four and a half times that of magnesium this would seem improbable, but the Japanese are working and talking about it.

At the beginning of 1934 manufacturers believed that Japan had at last become self-sufficient in ammonium

sulphate and anticipated a surplus. The output was expected to reach 900,000 tons. Actually, however, production barely touched 800,000 tons, against a domestic demand of nearly 1,000,000 tons, so that the country had to depend on imports to make up the balance. The comparatively low output was blamed on the scarcity of secondary electric power. All the nitrogen fixation plants have contracts with the power companies to take power only when surpluses are available at the hydroelectric stations. With the droughts which Japan has suffered during the last two years this goal has not yet been achieved. However, for the year 1935, the production capacity for Japan proper, Chosen and Manchoukuo has reached 1,625,800 tons.

Ammonium sulphate is the only artificial fertilizer consumed in Japan which has made steady gains from year to year. This is due to its adaptability for all kinds of food products other than legumes and to the ease with which it can be handled. Bean cakes, in particular, have lost ground.

Superphosphates have been struggling under rural depression. The lower exchange rate of the yen and the conclusion of the International Phosphate Agreement last year combined to send up the prices of imported phosphatic ores. The domestic productive capacity at present amounts to about 1,955,000 tons but all of this is not worked. Japan also is depending on her South Seas Mandates for phosphorites rarely found in Japan, such as those produced in Angaur Island at an annual output of 60,000 tons.

As far back as 1915 the Hoshi

Principal Japanese islands showing points of chemical production



Pharmaceutical Co., Ltd., set about making Japan the foremost producer of alkaloids, producing morphine, cocaine, quinine and atropin. In 1917, in co-operation with the Sankyo, Dai Nippon and Radium companies, an association was formed for the cultivation of poppies and the establishment of an experimental farm in Mishima County, Osaka Prefecture. It was decided also that cinchona trees could well be raised in the interior of Taiwan. Peppermint was also produced in enormous quantities and still is in Hokkaido, Hiroshima, Okayama and Taiwan. Since 1918 this group has been exporting quinine worth over a million yen per year to Europe and America.

Japan is now planning to buy patents dealing with titanium compounds from Germany. Bargaining is going on between the Native Industry Co., formerly the Tobatta Foundry, and the I. G. Farbenindustrie, for the Japanese acquisition of the latter's method of making such compounds. The plan is to form a company in Japan, with a paid capitalization of 1,500,000 yen, of which I. G. Farbenindustrie would subscribe 500,000 yen in patent rights and 100,000 yen in cash, with Native Industry subscribing the remainder. A factory would then be built in Ube, Yamaguchi Prefecture. Such compounds are used in making face powder, paint, rayon yarn, and munitions.

(The following information is taken from the "Japan Trade & Engineering Supplement," Tokyo.—Ed.)

The Japanese cellulose wrapping film industry is much overbuilt and has been in the throes of a serious depression which now bids fair to be to some extent alleviated through extensive merging of the industry. The 13 firms now in the business have a combined production capacity said to be in excess of 30,000 reams per month. After the proposed mergers are completed four large firms will control the entire industry.

Production of ammonium sulphate in Japan during the current year is scheduled to reach a total of 1,297,000 tons

(Please turn to page 277)



General view of Solvay alkali plant, Yung-Li Chemical Works, Ltd.

Current Developments Forecast Industrialization of China

By HUNG Y. CHANG

Professor of Chemical Engineering
Managing Editor, "Journal of Chemical Engineering of China"
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CHINA, which in the past has had cause to be proud of her ancient inventions and discoveries, now finds herself far behind in the chemical world of today. A brief review of the Chinese Maritime Custom Reports reveals that China annually imports a great variety of chemical products ranging from basic heavy chemicals to such fine and luxurious things as perfumes.

Among all the chemical industries, acids and alkalis are basic. Not including the many old-fashioned home-factories, there are ten acid and eight alkali works in this country. Plants, installed since 1934, include two vanadium contact sulphuric acid plants, one electrolytic caustic and hydrochloric acid plant, one synthetic nitric acid plant, one wood distillation plant and one additional unit of the Yung-Li Solvay plant. On account of the

lack of developments in the related industries, the demand for acids is rather small. The production of all the acid plants amounts to about 40,000 tons per year, supplying about four-fifths of the total requirements. In the case of alkalis, the demand is much larger. The Yung-Li Solvay plant, with a daily capacity of 150 tons, accounts for about 90 per cent of all the soda ash manufactured in China. The annual production of caustic soda approximates 8,000 tons, just about one-half of the 14,000 tons imported per year. The import on soda ash has averaged about 12,000 tons per year for last few years.

On the list of imported chemicals, ammonium sulphate almost always has the predominant position; but since 1930, it has shown a continually decreasing trend from the maximum of 250,000 tons in

Imports of Chemical Products Into China

Commodity	Imports in Gold Units 1933	1934
Petroleum Products:		
Gasoline, naphtha and benzine.....	10,937,703	9,829,425
Kerosene.....	44,797,828	20,232,250
Fuel oil.....	9,708,815	10,825,041
Lubricating oil.....	4,658,127	3,346,041
Petroleum wax.....	4,188,497	4,073,559
Artificial Dyes:		
Aniline dyes and coal tar colors.....	4,632,212	5,401,271
Indigo, not over 20% strength.....	2,610,520	2,853,861
Indigo, 30% strength.....	2,966,381	2,705,143
Indigo, 60% strength.....	2,305,916	2,418,492
Paper:		
Newsprint.....	6,111,440	6,211,276
Cigarette paper.....	2,808,303	1,827,023
Printing paper, wood pulp free.....	2,532,098	1,319,256
Box board.....	2,441,074	1,591,607
Machine-glazed paper.....	2,468,468	1,200,152
Kraft paper.....	870,106	1,119,435
Sugar:		
Refined.....	8,067,240	6,827,854
Above 98° polarization.....	7,199,591	4,936,180
Between 86°-98° polarization.....	2,419,936	1,716,399
Below 86° polarization.....	2,644,340	2,332,340
Artificial Silk:		
Floss and yarn.....	6,260,825	3,259,800

*Approximately \$0.40

1930 to 80,000 tons in 1933 and 40,000 tons in 1934. Decreased purchasing power on the part of Chinese farmers may mainly account for it; however, other factors, such as incorrect usage in past years, also contribute. Such difficulties presumably will not last long and when the tide turns, the demand should be even greater. A Haber-Bosch plant, now un-

der construction near Pu-Kow, is designed to produce 150 tons of ammonium sulphate per day. A similar but smaller plant is also under construction in Canton. It may be mentioned here, too, that the 50-ton superphosphate plant, installed in Canton last year, is now in regular operation.

When one looks still more carefully into the import statistics, it is revealed that among all the chemical imports, petroleum products head the list and are valued on the average at about 60 million gold units per year. (The gold unit is equivalent to about \$0.40 at the present rate of exchange.) Next come artificial dyes, paper and sugar, each at about 17 million gold units and then artificial silk at about 10 million gold units. The accompanying table shows more clearly the nature and magnitude of each item in detail, anything less than one million gold units having been omitted. Because of the illegal smuggling which has in recent years assumed such tremendous proportions, the figures on artificial silk shown here are probably much lower than the actual. The annual imports from 1927-1932 averaged about 15 million gold units.

Thus, on basis of these five large import groups alone, China is annually liable for the sum of about 150 million gold units. In order to balance her trade, she has to export a huge quantity of raw materials, which is usually insufficient to achieve a favorable balance. Of course, under the circumstances, the most logical thing for China to do is to start manufacturing herself. This is what she has planned in the past few years. It is notable that, during last two years, eleven large plants came into existence with a total capital expenditure of about 40 million dollars. This does not include the 5-million dollar paper and pulp plant nor the 7-million dollar rayon plant which are still under consideration. Aside from these, one should not forget that there are also a large number of smaller plants which were installed since 1934 and are not included here. As to the nature of these plants, it may be mentioned that the eleven plants include three acid and alkali works, four sugar works, a paper mill, one alcohol plant and two fertilizer plants. In the field of synthetic dyes, sulphur black is now produced rather extensively. Aniline dyes and synthetic indigo have not yet been touched. Practically, little has been done or can be done on petroleum, except in the finding of proper substitutes. Wood charcoal motor trucks are now in regular operation. Alcohol would come into general use were it not for its slightly higher cost.

This summary portrays briefly the general status of chemical industries in China. One can safely conclude that the industrialization of China is commencing. In the field of acids and alkalis, she is now more or less independent and self-

sufficient. Progress made in other fields of chemical industries is noticeable, and constantly gaining ground. The Chinese people, universally known for their handicraft skill, are equally apt in modern engineering. Many foreign engineers, resident in China, will testify to the ingenuity and skill with which certain engineering feats have been executed by the Chinese.

As to equipment and apparatus, all important pieces are imported from abroad. Of course, large concerns such as the Yung-Li Chemical Works design and

construct as much as possible of their own equipment. It would seem that for years to come, assuredly for next 10 or 15 years, China will continue to import from abroad her supply of fine instruments and equipment. Remembering that China is vast country and that her almost inestimable potential resources are to be found largely in the interior provinces, rather than near the port cities, it will be clear that the present industrialization is merely an introduction to the greater developments of the future.

Potash and Bromine Among New Products of Palestine

By Prof. Dr. WALTER ROTH
Haifa, Palestine

AS AN industrial district the "Holy Land" is something new and unusual; at this time, it even may appear premature because Palestine still is predominantly an agricultural country. Industry is in its infancy although being developed in recent years by Jewish immigrants, especially from Germany. There are very few large industrial concerns. The greater part of activity is handled by small and moderate-sized enterprises, the latter ones constituting the first step in the transition from manual labor to manufacturing. Moreover, Palestine is a small country with but 10,000 square miles and just over one million inhabitants of which 400,000 are still on a primitive standard of living. Seventy-five per cent of all the enterprises manufacture consumer

goods; this figure includes the construction industry which was booming during the last few years because of the heavy immigration.

Total imports into Palestine were valued at \$89,000,000 in 1935, \$75,000,000 in 1934, and \$55,000,000 in 1933. Exports for the same years were \$21,000,000, \$16,000,000, and \$12,000,000. Principal exports are citrus fruits, edible oils, soap, cement and artificial teeth. Sugar, varnish, caustic soda and fertilizers take the lead among imports.

The status of the country as mandate territory causes certain difficulties, imports being open to every country irrespective of its own tariff policies against Palestine. This condition forced the closing of the Meshi Silk

Plant of Palestine Potash, Ltd., on north shore of Dead Sea, showing bromine and power plants in foreground and salt beds in background. In 1935 about 20,000 tons of potassium chloride and 400 tons of bromine were produced; magnesium chloride production now beginning



Mills, near Tel-Aviv, and others because of Japanese competition; recently operations at these mills were resumed after the introduction of protective tariffs. It may be presumed that this policy of our government will be continued as it is devoting more attention to our young industries. At the same time, British industry, finance and trade are showing increasing interest in local developments.

Chemical industries share the fate of other infant enterprises. A few larger plants, organized several years ago, have overcome initial difficulties and become established in the world markets. We mention the Palestine Potash, Ltd., Jerusalem, incorporated in England and granted a 75-year concession on January 1, 1930, for the exploitation of the Dead Sea. Potassium salts and bromine are produced by natural evaporation of sea water containing 16 feet below the surface about 275 grams of salts per liter (KCl, NaCl, MgCl₂, CaCl₂, CaSO₄, MgBr₂); the

modern plant was erected in 1925 by the Palestine Oil Industry Shemen, Ltd., Haifa, also an English concern. One million dollars has been invested in the works, equipped with the latest automatic machinery, laboratory and shop, as well as welfare institutions. Olive oil is the main product, others are coconut, sesame, sunflower, and arachis oils, toilet and household soap, soapsuds, toothpaste, etc. At present, the plant is giving work to over 300 men; the output is valued at over 1.7 million dollars and is distributed to 70 countries. Last year, a second modern oil mill started in operation; its owner, the Izhar Oil Industry of Palestine, Ltd., Tel-Aviv, invested about \$200,000 and has 80 men on the payroll. The equipment includes automatic presses for copra, sunflower seeds, and so on, as well as a grease extraction plant for the oil-cake because the cattle raisers prefer greaseless feed in this climate. The extracted oil and the soapstock obtained in the refinery are utilized for

Zori and Bari plants, Tel-Aviv and Teva, Jerusalem. At the Chemical Congress of Jerusalem in December, 1935, Prof. Dr. B. Zondek proposed to make hormones from mare's urine. The Daniel Sieff Research Institute, Rehoboth, is synthesizing hormone-like preparations besides making preventives against a special kind of cattle malaria. Research extends to various problems of the citrus fruit industry, pectines, synthetic essential oils, the utilization of waste and byproducts of the first brewery in Palestine at Rishon-le-Zion and so on.

Other industries related to the chemical industry proper are: the Portland Cement Co., Nesher, Ltd., near Haifa, the largest industrial plant of the country, the Shimshon Palestine Portland Cement Works, Ltd., Tel-Aviv (certain agreements have been concluded between these two concerns); the milling and textile industries; the Palestine Foundries & Metal Works, Ltd., manufacturing sanitary installations and exporting to Syria in agreement with the international syndicate; the Palestine Window Glass Works, Phoenicia, the Haifa Silicate Brick Factory, and the American Porcelain Tooth Co., Ltd.

In comparison with other industrial countries, Palestine is of little importance. However, considering the almost complete lack of raw materials, the results achieved within a few years have been noteworthy. It is likely that continued progress will be made in view of the favorable geographic position, the progressive spirit of the population and the influx of large capital funds. The Fair of the Levant which opened on April 30, demonstrated what has been accomplished.

(Continued from page 275)

and present capacity is said to be in the neighborhood of 1,800,000 tons. Approximately 180,000 tons is to be imported from Europe, America and Manchukuo during the year and with the carry-over from last year, consumption is expected to reach 1,476,600 tons. Actual 1935 production of the various firms is presented below, with 1936 estimates.

	Actual Output, 1935, Tons	Estimated Output, 1936, Tons
Korean Nitrogenous Fertilizer Co.	343,000	380,000
Showa Fertilizer Co.	160,000	210,000
Sumitomo Chemical Eng. Co.	70,000	80,000
Electro-Chemical Eng. Co.	60,000	60,000
Nippon Nitrogenous Fert. Co.	50,000	50,000
Dai Nippon Artif. Fert. Co.	54,000	50,000
Miike Nitrogen Eng. Co.	39,000	50,000
Asahi Bemberg Rayon Co.	9,600	6,000
Toyo High Pressure Eng. Co.	41,500	100,000
Ube Nitrogen Fert. Co.	44,000	70,000
Yabase Engineering Co.	15,800	30,000
Nippon Synthetic Chemical Co.	600	600
Byproduct ammonium sulphate produced by gas companies and iron and steel works	50,000	50,000
Manchurian Chemical Eng. Co.	90,000	150,000
Total	1,027,500	1,296,600



Oil expellers, Palestine Oil Industry Shemen, Ltd., at Haifa

specific gravity of the water is 1.1725 at 73 deg. F. The salts are exported to England and sold by C. Tennant Sons & Co., Ltd., London. The company has been able to reduce its operating costs and to extend its operations to the southern coast of the Dead Sea. A connection with the Gulf of Akaba enhances prospects for exports to India, Australia and South Africa. This induced the German-French Kali-Syndicate recently to enter into an agreement favorable to the potash company. The Palestine Salt Co., Ltd., has extracted common salts from sea water on the coast, south of Haifa, since 1922.

One of the oldest industries in Palestine is the production of oil and soap. Primitive methods prevail in what is to a large extent a home industry. A

making soap. Another product is high grade olive oil for export.

Essential oils have been marketed since 1920 by the Natural Flower Oil & Essential Oil Factory, Benjamina near Haifa, a modern extraction plant operating with petroleum ether and steam distillation. From 1931 to 1933, over 220 lb. of jasmin oil have been exported, mostly to France; jasmin is in bloom from July to November in this country. The oil yield is twice as high as in southern France. Other products are geranium, peppermint, and absolute essential oils and bouquets. The Palestine Frutarom, Ltd., Haifa-Bay, also manufactures essential oils for export.

Manufacture of pharmaceuticals is still in its early stages; we might mention the Hillel-Werke, Haifa-Bay, the

Since the War many changes have taken place in the alkali industry of the world. Prior to the conflict most of the world industry, with the exception of independents in the United States, England, France, Germany and Russia, was in one manner or another associated with Solvay & Cie., of Belgium, with the result that concerted action was the rule. Since then, however, nationalistic tendencies have largely altered the original alignments. Only recently has a revival of the former appreciation of common interests appeared.

By HARALD AHLQVIST

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ALKALI INDUSTRIES Girdle the GL

A GENERAL STUDY of the alkali industry leads into a field covering the entire world. Personal observation of the whole is hardly possible, and published information is very scarce. Statistical data are in many cases several years old, and individual developments are surrounded with great secrecy. A detailed accuracy is therefore not claimed for this article, but it is believed that it presents a fair sketch of the present conditions in the industry. The scope of a magazine article does not permit detail observations, and electrolytic manufacture of caustic soda has only incidentally been mentioned.

Political and economic effects of post-War conditions have had a striking influence on the international situation. There is evident a clear desire toward independence, both national and individual, though lately a revival of the former appreciation of common interests has reappeared. Although before the War the alkali industry of the whole world was characterized by concerted action, which resulted in great benefits to producers and consumers alike, the War and the after effects of the War altered conditions radically. Before the War a community of interests was fostered by the exchange of informations, by adherence to apportioned markets, reasonable price reductions, and so on. The center of this unofficial combine was Solvay & Cie., of Belgium, which, with its associates in other countries exercised a dominant influence on the alkali industry. While each associate acted independently, an interference in the sphere of interest of another associate was an unusual occur-

rence. There existed in several countries, notably in the United States, England, France, Germany and Russia, independent alkali producers, whose activities had to be taken into account. With few exceptions their productions were relatively small, however, and their methods of operation only rarely were comparable with the operations of the members of the combine. Hence their influence on the world situation was only incidental.

The War brought on the first partitions from the combine through the nationalization of the soda plants in the U. S. S. R. The next step was the formation of the Allied Chemical & Dye Corp., whereby The Solvay Process Co. was separated from the combine, next followed the formation of Imperial Chemical Industries, Ltd., which absorbed Brunner, Mond & Co. How many, if any, ties remained between Solvay & Cie. and Brunner, Mond & Co. is not known. The result of this division was a recognition of a more national interest of the several components of the former combine and a closer approach and cooperation of these components with the independent companies in their respective countries. There were thus formed several distinct groups, each one predominating in a more or less restricted area.

On the European continent Solvay & Cie. retains its position as the leading alkali producer, through its own factories in France and Belgium and through its participation in the operations of its associates in most of the other countries. The leading plant in France is at Dombasle, smaller ones are

at Giraud, Sarralbe, Chateau-Salin, all owned by Solvay & Cie. In addition there is a plant at Dienze and one belonging to St. Gobain, one to Marchéville-Daguin & Cie., and one to the French government. The total yearly capacity of the plants is over 700,000 metric tons of soda ash. The present production is well over 500,000 tons per year. Domestic consumption is well taken care of and there are no imports. The exports have been considerable, in 1934 amounting to 94,768 metric tons of soda ash and 29,295 tons of caustic soda.

The principal destinations are the Netherlands, Belgium, Algeria, Indo-China, Tunis, Turkey and Bulgaria, all, with the exception of Belgium, having no domestic soda production. In Belgium Solvay & Cie. operates a plant at Couillet, but the domestic production is not sufficient to cover the demand, principally on account of the large glass industry. The import is therefore proportionately very high. In 1934 there was imported 56,189 metric tons of soda ash and 8,721 tons of caustic soda, most of it from France. At the same time there was exported 2,311 metric tons of soda ash and 51 tons of caustic. Most of it went to Bulgaria, Greece, Portugal and the Congo.

The Netherlands has no soda production. It imported in 1934, 46,361 metric tons of soda ash and 16,988 metric tons of caustic. Negotiations conducted in 1934 with the European cartel for the erection of a soda plant seem not to have led to any result.

In Switzerland an independent plant was built in 1915 by the Schweizerische Sodafabrik, A. G., at Zurzach near



the GLOBE

Basel. After many difficulties the plant was taken over by Solvay & Cie., equipped with adequate apparatus and is now reported to produce more than 90 per cent of the requirements of Switzerland.

Before the War Italy had no soda plant. Through the peace treaty the Montfalcone plant of the Soc. Anon. Adria per l'Industria Chimica became Italian. During the War it was badly damaged but it was repaired and started again in 1925. In 1928 it was purchased by S. A. Soda Solvay, but was shut down in 1928. In the meantime S. A. Soda Solvay had in 1919 built a new plant in Rosignano, which is said to have a capacity of 600 metric tons per day. This does not seem to be adequate for domestic requirements because in 1935 the Italian government granted permission to enlarge the plant. The alkali production in 1933 was 111,000 metric tons of soda ash, and in 1934, 71,350 tons of solid caustic and 50,845 tons of liquid caustic. The liquid caustic presumably came mostly from electrolytic plants. Imports and exports are negligible.

Spain, originally a producer of soda from sea weeds, lost this industry in competition with the LeBlanc process. Modern soda industry started in 1908 with a plant at Torrelavega, built by Solvay & Cie. There is also a small independent electrolytic caustic soda plant. Production in 1933 was 46,460 metric tons of soda ash and 35,020 tons of caustic soda. Only small imports are reported.

Germany is the largest producer of soda ash on the continent. There are a

number of plants, all being members of the Syndikat Deutscher Sodafabriken G. m. b. H., with headquarters at Bernburg. The industry is under government regulation and in 1935 an increase of producing plants was prohibited. The principal member of the syndicate is Deutsche Solvay-Werke, A. G. But there are a great number of other companies listed as soda producers. It is difficult to determine in how far they influence the total production, because in several cases the soda ash distributed is not originally produced but recovered in other industries. The total yearly capacity is about 1,144,000 metric tons of soda ash and 125,000 tons of caustic. The capacity is considerably larger than the domestic requirements. There are no imports; the exports have gradually diminished as appears from this listing:

Year	Soda Ash, Metric Tons	Caustic Soda, Metric Tons
1932	94,654	13,350
1933	70,455	13,390
1934	47,547	8,881

Poland has two soda plants, one at Montwy and one at Podgorze. Solvay & Cie. is interested in both. The capacity of the plants is greater than the domestic requirements and there has been some export.

Year	Soda Ash, Metric Tons		Caustic Soda, Metric Tons	
	Production	Export	Domestic Sale	Export
1932	50,100	5,739	11,400	545
1933	48,180	4,515	15,065	865
1934	49,100	8,630	15,350	900

No soda ash is produced in the Baltic Republics, the domestic demand being met by imports. These amount in Latvia and Estonia to about 2,000 metric tons of soda ash and 1,000 tons of caustic soda per year; in Lithuania to 1,000 metric tons of soda ash and

500 tons of caustic soda; in Finland to 8,000 metric tons of soda ash and 2,500 tons of caustic. Sweden has no soda ash production but manufactures about 4,000 metric tons of electrolytic caustic per year. Import of soda ash and bicarbonate combined is about 30,000 metric tons per year and 2,000 tons of caustic. Norway produces about 1,500 metric tons of electrolytic caustic per year and imports 1,500 tons. Soda ash imports increased greatly, reaching a maximum in 1932, but diminished since then. In 1933 a soda plant was built in Heroja with a capacity of 18,000 metric tons per year. Most of the production is used in sodium nitrate manufacture. Norwegian imports have included:

Year	Soda Ash, Metric Tons	Caustic Soda, Metric Tons
1929	25,262	.....
1930	35,030	.....
1932	62,200	.....
1933	40,028	.....
1934	13,246	1,428

Denmark produces no soda ash and no caustic. A plant at Aarhus for the production of soda from cryolite has long been shut down. Imports in 1934 were 16,660 metric tons of soda ash and 5,168 metric tons of caustic.

Austria produces soda ash at Ebensee in a plant belonging jointly to Solvay & Cie. and Verein für Chemische und Metallurgische Produktion, Aussig. Annual production is about 45,000 metric tons, of which 10,000 tons is exported. Caustic soda, for which the demand is about 3,000 tons per year, is produced in two small electrolytic plants.

Czechoslovakia has a soda ash plant in Nestomitz, jointly owned by Solvay & Cie. and the Aussiger Verein. The annual capacity is reported to be 120,000 metric tons and the production about 90,000 metric tons. In normal times there is no import and no export. Caustic soda is manufactured at Nestomitz

and at Aussig. Annual production amounts to about 20,000 metric tons, import and export being insignificant.

Hungary has no soda production, imports amounting to about 8,000 metric tons of soda ash and 6,000 tons of caustic soda per year. In 1935 the government granted a concession to Krebs Chemical Co. of Berlin to build a soda plant to cost 3,500,000 pengos.

Yugoslavia has two soda plants. The larger one with 200 metric tons daily capacity is located at Lukavac and in this Aussiger Verein and Solvay & Cie. are interested. The smaller one is located at Hrastnik. Domestic requirements are about 5,000 metric tons of soda ash per year and 3,000 metric tons of caustic. Exports reached a peak of 22,485 metric tons of soda ash in 1929, but decreased to 8,338 tons in 1932.

Rumania acquired through the Versailles treaty two soda plants in Transylvania, formerly part of Hungary. These are part of the Solvay & Cie. and Aussiger Verein interests. There is also an electrolytic caustic soda plant with an annual capacity of 3,000 metric tons. The annual production is about 20,000 metric tons of soda ash and 10,000 metric tons of caustic. Exports amount to 2,500 metric tons of soda ash and 4,500 tons of caustic per year. There are no imports.

Bulgaria, Greece, Portugal and Turkey have no soda production, the combined imports amounting to about 15,000 metric tons of soda ash and 10,000 tons of caustic soda.

For colonies like the Congo, Tunis, Algeria, Palestine, Tripolis, Cirenaica, Madagascar, Indo-China, Tonking, New Caledonia, Erytra, Dahome, Natal, Morocco, Netherlands India, etc., no detailed figures are available, the presumption being that they are supplied by Solvay & Cie. controlled factories in the respective mother countries.

The U. S. S. R. acquired by compulsory nationalization the plants located within its borders. Among these were the soda plants belonging to Lubimoff, Solvay & Cie., at Donetz, with 400 metric tons daily capacity and at Beresniki, with 200 metric tons capacity. A third plant located at Slavjansk, operated with apparatus of the Honigmann type, had a capacity of 150 metric tons. The plant in Donetz has now been enlarged to 600 metric tons capacity and provisions made for an additional 200 tons capacity. Plans have been completed for a new plant at Slavjansk, to have at the start a capacity of 600 metric tons per day and later to be enlarged to 1,200 tons per day. The equipment for the new plant will be of the Solvay type and when it is in operation the old plant will be abandoned. A new plant has also been projected for Beresniki to have a capacity of 600

metric tons per day. No reports are available if anything has been accomplished. Another big plant is planned for Derbensk, on the Kara Bugas, to manufacture soda ash from sodium sulphate. The production of natural sodium sulphate has been reported as follows:

Year	Metric Tons	Year	Metric Tons
1930	11,846	1932	84,502
1931	28,193	1933	97,328

At the same time the manufacture of natural calcined soda has been reported. It is possible that this represents a conversion of natural sodium sulphate to sodium carbonate. The production has been:

Year	Metric Tons	Year	Metric Tons
1930	2,644	1932	3,259
1931	2,669	1933	5,992

The soda industry suffered greatly during the War and through the revolution. In 1912-13 soda ash production was 159,000 metric tons and in 1915-16 only 82,660 tons. In one year during the revolution the production is reported to have been only 5 per cent of that before the War. No figures are available for the years 1916-25. From the latter year on there has been a steady increase, in 1925-26, 136,731 metric tons and in 1930-31, 370,000 metric tons. Production at present may be slightly higher. In spite of the domestic demand which was greatly in excess of the production, a considerable quantity was exported which in 1933 and in 1934 was at the rate of over 40,000 tons. As this had a decidedly disturbing effect on international trade, especially in Europe, therefore in 1934 an agreement was entered into with the European combine, whereby the European market was reserved for Solvay & Cie. interests, while U. S. S. R. was to provide the Asiatic market. Since then the exports from U. S. S. R. have decreased, amounting to only 1,162 metric tons for the first five months of 1935 as against 16,235 metric tons for the corresponding period in 1934. The domestic requirements for 1934 were officially estimated at 999,000 metric tons which means that there is a great shortage.

Imperial Chemical Industries, Ltd., which was organized in 1926, absorbed the two principal soda producing companies in England, namely, Brunner, Mond & Co. and United Alkali, Ltd. In 1924, the last year for which complete statistics were published, the combined production of sodium compounds was 1,493,000 tons, of which 500,900 tons was exported. As there was an import of 94,200 tons, the domestic consumption was 1,086,300 tons. In 1933 the production of combined soda ash, bicarbonate and caustic soda was 1,307,824 tons and the salt used for alkali production was 1,742,272 tons. In 1934

the salt used for the same purpose was 1,898,400 tons. On the basis of the same unit consumption of salt, the soda ash, bicarbonate and caustic soda production would then have been 1,425,225 tons. The export of soda ash in 1933 was 188,882 tons and of caustic soda 99,332 tons. It is reported that the principal market for British export is the Far East which absorbs about 66 per cent of the exported soda ash and 50 per cent of the exported caustic. Next in importance is South America. The British dominions and colonies are also important customers, although some of them are wholly or partly self sustaining.

In Canada a soda ash plant was built in 1917 jointly by the Solvay Process Co. and Brunner, Mond & Co. The plant is managed by the Solvay Process Co., and is reported to have a capacity of 200 tons of soda ash per day. Caustic soda is manufactured by the Canadian Salt Co., having a yearly capacity of about 22,000 tons. A new electrolytic caustic soda plant was erected at Cornwall, Ont., in 1934 by Canadian Industries, Ltd. There is also some natural soda recovered at Last Chance Lake in British Columbia. The production may amount to 4,000 tons of soda ash per year. In spite of the domestic production, the demand has to be supplemented by imports. The United States supplied, in 1935, 2,437 tons of soda ash and 7,294 tons of caustic soda.

Australia at present produces no soda. An installation for this industry, however, is anticipated in the near future. In 1935 a permit was obtained from the South Australian government by the Imperial Chemical Industries to build a plant at Port Adelaide and mining leases were granted. The plant is to cost between £1,000,000.00 and £1,250,000.00. Imports of soda ash are well over 25,000 tons per year. In 1930 England supplied 11,707 tons, Kenya Colony 5,566 tons and the United States 427 tons.

In South Africa soda ash is manufactured on a small scale from natural soda deposits. The plant is located at Hamans Kraal, near Pretoria. In 1934-35 the production was 2,811 tons, of which 1,907 tons was manufactured from brine and 904 tons from trona. The production is far less than the consumption, imports amounting to over 15,000 tons of soda ash per year, most of it from England. In the Kenya Colony is located a well known natural soda deposit at Lake Magadi. This has been exploited since 1911 with varying success, the deposit being estimated to contain 200 million tons of sodium sesquicarbonate. Imperial Chemical Industries is a shareholder in the establishment and has assumed the management. The production in 1933 was 48,217 tons of soda ash and in 1934 it was 34,532

tons. Exports were, in 1933: to Japan 27,580 tons, to Australia 12,320 tons, to India 3,024 tons, to Argentina 1,793 tons and to other countries 3,500 tons.

In Egypt crude natural soda is recovered and converted to caustic by the Egyptian Salt & Soda Co., Ltd. The caustic plant was built in 1927. Production amounts to about 500 tons of soda ash and 3,000 tons of caustic per year. Exports are about 200 tons of soda ash and 1,000 tons of caustic, mostly to Palestine, Syria, Greece and Cyprus. Imports include about 1,000 tons of soda ash from England.

In India a small quantity of crude soda ("chanio," the local name for trona) is recovered in the Sind. The total production is only about 750 tons, though the Indian Geological Survey has estimated that 5,000 tons could be recovered. A small ammonia soda plant exists at Dhanghadra, in Kathiawar. It was built for a production of 60 metric tons soda ash per day, but has not come quite up to expectations. Imports of soda ash in 1935 were 69,216 tons, and 20,168 tons of caustic soda. Import duty on soda from points in the British Empire is 27 per cent ad valorem and 30 per cent from all other places. In 1935 Imperial Chemical Industries obtained a five-year option to take up a 50-year monopoly on certain chemical resources and thus establish an alkali industry in the Punjab.

China consumes approximately 200,000 tons of soda ash annually. It is rather difficult to correlate this with the production because reports on domestic operations are very vague. About 90,000 tons is produced from natural crude soda, 12,000 tons is washed from alkaline soil, 23,000 tons is imported from Mongolia, 19,000 tons is imported from Magadi, 34,000 tons is imported ammonia soda and 14,000 tons is domestically produced ammonia soda. Import of caustic in 1934 was 21,717 tons. Attempts have been made to render China independent of imports but as yet these are far from realization. Only the Pacific Alkali Co. plant at Taku is of importance. Conditions, however, are such that with sufficient capital and political rest in the country, a fully adequate industry could be developed.

Japan has in recent years been able to establish an important alkali industry. In 1880 the Kabushiki Kaisha alkali works started a soda plant using the LeBlanc process. In the following years three other plants were constructed along similar lines. These have now disappeared and soda ash is produced by the ammonia soda process. There are three producers, the Asahi Glass Co., the Nippon Soda Co. and the Dai Nihon Artificial Fertilizer Co. The combined capacity of these plants is well over 400,000 tons per year calculated as soda ash.

More than half of the output is converted to caustic soda. In 1934 the total caustic soda production was 181,830 tons, with soda ash produced for sale at the rate of 179,000 tons per year.

The caustic soda production seems to have exceeded the domestic demand, because against imports of 11,000 tons there were exports of 13,600 tons. The production of soda ash was not yet sufficient and with imports of 41,100 tons, only 17,100 tons was exported. Most of the imported soda ash came from Kenya. In connection with Japan may be mentioned Manchoukuo which has large deposits of natural soda. The exploitation is primitive. The production at Barga is about 8,000 tons per year and at Nonni River about 10,000 tons of soda ash is produced in more than 50 native refineries. At Fuyu 850 tons per year is produced and in South Manchuria 2,000 tons from various lakes.

Latin America, with which I include South America, Central America, Mexico and some of the West Indies, presents a unique picture in the soda industry. Apparently it is the only market which is free for all to enter and the international competition is keen. This has been of considerable benefit to the natives, especially in the last 5 or 6 years, since alkali prices were materially lowered. On this account there has, until lately, been no urgent desire to establish local alkali plants, particularly in view of the relatively small consumption in the individual states, and the rather difficult raw material situation in most countries. The increase in nationalistic sentiment, however, is now inciting a desire for greater industrial independence for which soda production is vital. Active investigations and actual starts at soda production are therefore being made. Adequate statistics of imports and consumption are only rarely obtainable.

Thus far, only in Venezuela has an ammonia soda plant been established. It is reported to have a capacity of 1,200 tons of caustic, 400 tons of soda ash and 150 tons of bicarbonate per year. Various reports about its operation do not give a clear picture of its success. Small quantities of soda are also recovered from some natural soda lakes. The latest reports of imports are from 1933, when they amounted to 1,003 metric tons of caustic and 195 tons of bicarbonate.

All the other countries, relying wholly on imports to satisfy their requirements of soda ash, bring in 60,000-70,000 tons of soda ash and about the same quantity or slightly more of caustic soda, as the accompanying tabulation shows.

Mexico has some workable natural

Latin American Imports of Alkali

	Source	Year	Soda Ash, Tons	Caustic Soda, Tons
Mexico.....	Mostly U. S. A.	1935	13,463	13,488
Central America and West Indies.....	80% U. S. A.	1935	2,244	11,511
Colombia.....	{ 60% U. S. A. } { 30% England }	1930	1,824	200
Ecuador.....	Mostly England	Annually	230	200
Peru.....	Mostly England	Annually	7,000	2,000
Brazil.....	Mostly England	1933	10,000	23,800
Argentina.....	{ England, U. S. A., } { Japan }	1934	22,735	13,138
Uruguay.....		1933	2,072	1,504

soda deposits but these are not utilized. In Cuba a small electrolytic caustic soda plant was started, but has not yet been in operation. In Peru a small electrolytic caustic plant is in operation and the product consumed by the owner. Brazil has an electrolytic caustic soda plant with a capacity of 2,500 tons of caustic per year. The Imperial Chemical Industries has investigated conditions in Brazil for the installation of a soda ash plant to cost £1,000,000.

In the United States the soda industry has made the greatest strides. Free competition has been an incentive for the production of the highest quality product, while the per capita consumption of soda has put the country in first place as the largest producer of soda. Five large companies are now operating nine ammonia soda plants and four companies, each with one plant, are recovering natural soda. The daily capacity of the ammonia soda plants is well over 9,500 tons and of the natural soda plants, 350 tons. Some of the plants attained their full development in the course of 1935 and percentage capacity operation can therefore not be calculated from the production. The total production in 1935 estimated as soda ash was 2,519,000 tons, of which 594,000 tons was converted to caustic soda, making the marketable product 1,925,000 tons of soda ash and 440,000 tons of caustic soda. In addition 315,000 tons of electrolytic caustic is estimated to have been produced. The total volume available for sale was then

Exports of Soda Products From United States, 1935

Destination	Soda Ash, Tons	Caustic, Tons
Europe.....	10,995	3,119
Central America.....	236	651
Mexico.....	13,465	13,488
West Indies.....	2,048	10,860
South America.....	8,822	15,926
Asia.....	4,356	18,486
Canada.....	2,457	6,980
Australia and Africa.....	1,543	796
Total.....	43,922	70,306

1,925,000 tons of soda ash and 755,000 tons of caustic soda. The distribution of soda ash and caustic soda is shown in an article on the alkali industry in the February, 1936, issue of *Chemical & Metallurgical Engineering*. Imports in 1935 were insignificant, while the exports were as shown in the tabulation. The soda ash exported included 13,445 tons of recovered natural soda.

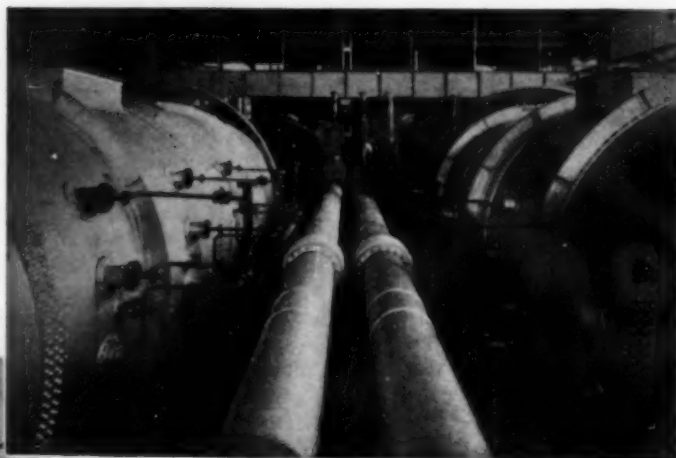
World Nitrogen Industry Survives International Crisis

By J. BRESLAUER, Dr. Sc.

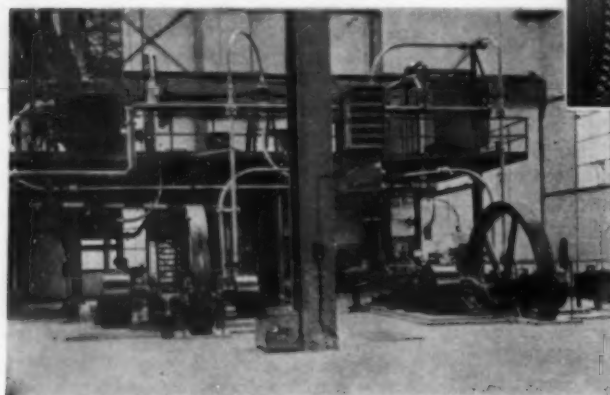
*President, Hydro-Nitro. S.A.
Geneva, Switzerland*

THE HISTORY of the nitrogen industry more than that of any other of our era constitutes a striking example of the lack of equilibrium which is one of the sombre consequences of the World War and against which we have had to struggle during the last decade and a half.

In fact, since the relations between the nations of the world are controlled less by primary economic forces and have become more a function of international politics, and since, moreover, the principle of autarchy has replaced the older and more logical considera-



**Above: Furnaces for cracking methane for hydrogen at Ewald, Germany.
At left: Compressors at French La Madeleine plant**



tions, tools of production have been created and destroyed with an insouciance which could not be greater if it were a question of fashion. An unequalled prosperity which brought about a fabulous construction of nitrogen-fixation factories in nearly all the European countries was followed by a crisis just as unjustified and artificial and this has continued up to the last few years. It was only in 1934 that the disastrous wave of pessimism was conquered, and we could coolly contemplate the nitrogen industry, a beneficiary, of course, of the development of war industries, to which it is an accredited supplier.

Today consumption has reached and exceeded the record (1.9 million tons) of the agricultural year beginning and ending July 1, 1929-1930. Each coun-

try is aspiring to as complete an independence as possible in the event of war and the initiative for new construction has been revived. The nitrogen producers, united in Europe by a Syndicate, have, moreover, come to agreement with overseas manufacturers, above all the Chilians, and seem to regard the future with an optimism, the basis of which we are now going to examine with the aid of timely statistics.

The world nitrogen industry has today a total capacity of about 3,490,000 tons of nitrogen per year, whereas the production for the agricultural year 1934-1935 slightly exceeded 2 million tons, distributed as follows:

(1) Byproduct.....	360,334
(2) Chilian nitrate.....	178,400
(3) Cyanamide.....	238,448
(4) Calcium nitrate.....	153,113
(5) Synthetic ammonia, etc....	1,111,071
Total.....	2,041,366

The last category, brought to the leading position during the War by the genius of the Germans, Haber and Bosch, with the aid of the Badische company and its distinguished chemists and engineers, has since been the object of numerous experiments and diverse efforts in different countries, as well in Germany as in England, the United States of America, Italy and France, where specialized engineers of great talent, such as Uhde, Pollitt, Claude, Casale, Fauser, Jones and their collaborators have brought to perfection and built factories in which synthetic ammonia and its derivatives are produced from different sources of hydrogen and nitrogen in the most varied ways.

There is no need here to develop at length the merits of each of the groups which have contributed so brilliantly to the creation of one of the greatest industries of the world. Nor can we enter into detail concerning the technical differences, special qualities and imperfections of the diverse methods whose distinctive characters we assume to be generally known by chemical engineers. Sufficient to note that during the long years of experience since the expiration of the basic patents, which forced the inventors to seek detours, the modern technique of the synthetic-ammonia industry has become more or less stand-

EDITOR'S NOTE: Data used in part for accompanying map and Table II kindly supplied by Chemical Division, U. S. Tariff Commission, Washington, D. C.

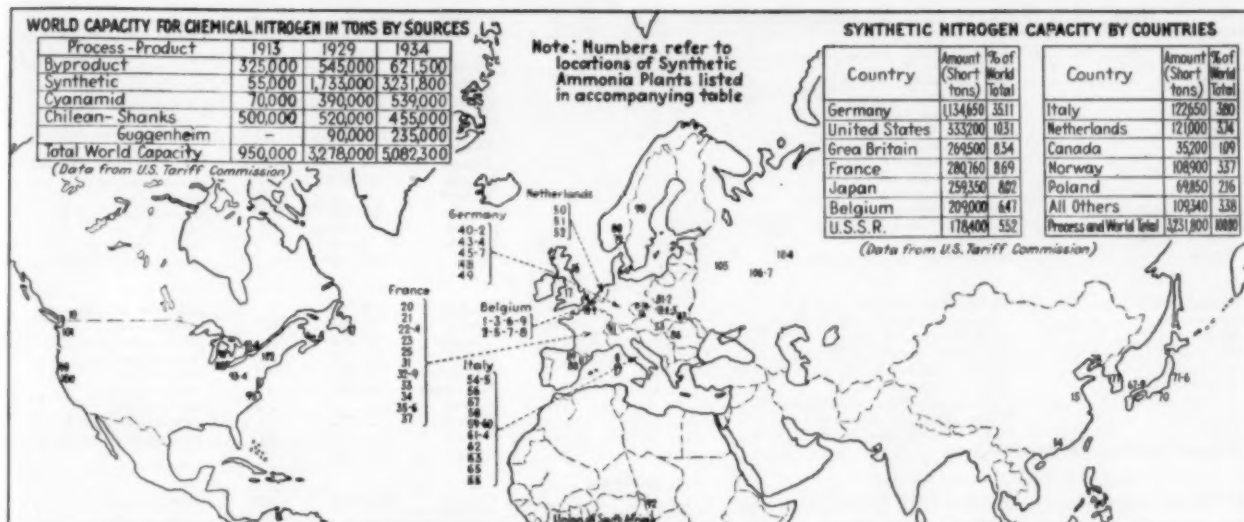


Table I—Maximum Capacities of Plants Operating or Under Construction April, 1936, for Ammonia Synthesis

No.	Place	Operating Company	Process	Metric tons N ₂ per year	Metric tons NH ₃ per day	Source of H ₂
BELGIUM						
1	La Louvière	Sté Fab. Engrais Azotés SAFEA	Casale	18,000	60	coke-oven gas
2	Leval	Charbonnage du Centre	Fausser		100	coke-oven gas
3	Marly	Sté des Prod. Chim. de Marly	Claude	26,200		coke-oven gas
4	Ostende	Union Chimique Belge	Casale	21,000	56	coke-oven gas
5	Ougree	Sté Belge de l'Azote	Claude	36,800		coke-oven gas
6	Selzaete	Etablissements Kuhlmann	N.E.C.	19,000		coke-oven gas
7	Tertree	Sté Carbochimique	Casale	39,000	120	coke-oven gas
8	Tilleurs	Eng. et Prod. Chim. de la Meuse (Ets. Kuhlmann)	N.E.C.	19,000		coke-oven gas
9	Willebroeck	Ammonia Synthétique & Dérivés	Fausser		80	coke-oven gas
CANADA						
10	Trail	Consolidated Mining & Smelting	Fausser		100	electrolysis
CZECHOSLOVAKIA						
11	Aussig	Verein für Chem. und Metal. Ind.	N.E.C.	2,800		byproduct
12	Ignatz	Sté Tehéco, Slov. de Prod. Azotés (Synthesia A. G.)	Claude	11,000		coke-oven gas
13	Semtin	Fabrique tchécoslovaque d'Explosifs	Haber	7,300		coke-water gas
CHINA						
14	Canton	Reconstruction Dept.	N.E.C.	2,880		coke-water gas
15	Pukow	Yungli Chem. Ind.	N.E.C.	11,500		coke-water gas
ENGLAND						
16	Billingham	Imperial Chemical Industries	Haber	23,500		coke-water gas
17	Brincorn	Imperial Chemical Industries	Haber	2,750		byproduct
FRANCE						
18	Anzin	Sté An. de Prod. Chim. Anzin (Ets. Kuhlmann)	N.E.C.	6,000		coke-oven gas
19	Bully-Grenay	Cie des Mines de Béthune	Claude	26,000		coke-oven gas
20	Carling	Sté Mosellane Ind. & Fin.	Casale	6,000	16	coke-oven gas
21	Chambery	Sté Elect. Chim. & Metallurgique	Jourdan	1,000		electrolysis
22	Choques	Sté des Prod. Chim. Marles-Kuhl.	N.E.C.	12,000		coke-oven gas
23	Decazeville	S.A. de Commentry-Fourchambault & Decazeville	Claude	5,000		coke-oven gas
24	Drocourt	Cie des Mines de Vicoigne, Noeux & Drocourt	Casale	6,000	15	coke-oven gas
25	Firminy	Cie des Prod. Chim. de Roche la Molière	Casale	9,000	24	coke-oven gas
26	Harnes	Sté Courrières-Kuhlmann	N.E.C.	19,000		coke-oven gas
27	Henin-Lietard	Sté des Mines de Dourges	Casale	6,000	15	coke-oven gas
28	Lens (Douvrin)	Sté Mosellane Ind. & Fin.	Mt. Ceniz		70	
29	Lievie	L'Ammoniaque de Lievie	Claude	7,500		coke-oven gas
30	La Madeleine	Ets. Kuhlmann	N.E.C.	19,000		coke-water gas
31	Montereau	Sté Chim. de la Gde Paroisse	Claude	2,000		coke-oven gas
32	Pont à Vendin	Sté Ammonia	Casale	11,000	30	coke-oven gas
33	Rouen	Sté Chim. de la Gde Paroisse	Claude	7,500		coke-oven gas
34	Soulom	Sté des Phosphates Tunisiens	Casale	18,000	48	electrolysis
35	Toulouse	Office National Industriel de l'Azote	Haber	22,000		coke-water gas
36	Toulouse	Office National Industriel de l'Azote	Casale	19,000	180	coke-water gas
37	St. Auban	Cie de Prod. Chim. & Elect. Metal. Alais, Frogee & Camargue	Casale	4,000	12	electrolysis
38	St. Etienne	S.A. des Houillères de St. Etienne	Claude	1,500		coke-oven gas
39	Wazier	L'Ammonia que Synthétique	Claude	22,000		coke-oven gas
GERMANY						
40	Herne	Hibernia Bergwerksgesellschaft	Mt. Ceniz		108	coke-oven gas
41	Herne	Mont Ceniz Gewerkschaft	Mt. Ceniz		81	coke-oven gas
42	Herten	Gewerkschaft des Steinkohlenbergwerks Ewald	N.E.C.	24,500		conv. coke-oven gas
43	Leuna near Ludwigshafen	I. G. Farbenindustrie A.G.	Haber	1,012,700		brown-coal water gas
44	Oppau near Ludwigshafen	I. G. Farbenindustrie A.G.	Haber			
45	Oberhausen Holten	Ruhrchemie	Casale	54,000	150	coke-oven gas
46	Piesteritz	Mitelldeutsche Stickstoffwerk	Fausser	4,500	15	gas from phosphate furnace & electr. coke-oven gas
47	Raxel	Gewerkschaft Victor	Claude	60,000		conv. coke-oven gas
49	Waldenburg	Stickstoffwerke Waldenburg A. G.	N.E.C.	22,800		
HOLLAND						
50	Ijmuiden	Kon. Ned. Hoogoveni & Staalfab.	Mt. Ceniz		60	coke-oven gas
51	Lueterade	Staatsmijnen	Fausser		150	coke-oven gas
52	Sliviskill	Cie Neerlandaise de l'Azote	Fausser		160	coke-oven gas
HUNGARY						
53	Petfűrdo	Government	N.E.C.	7,000		lignite distillation & water gas

(Continued on following page)

Table 1 (cont'd.)—Maximum Operating Capacities of Synthetic Ammonia Plants

No.	Place	Operating Company	Process	Metric Tons		Source of H ₂
				N ₂ per year	NH ₃ per day	
ITALY						
54	Bussi	Azogeno S. A.	Claude	2,500	..	byproduct
55	Bussi	Soc. Dinamite Nobel	Fausser	..	5	electrolysis NaCl
56	Coghina	Soc. Sarda Ammonia da Elettricit�	Fausser	..	12	electrolysis
57	Crotone	Soc. Meridionale Ammonia	Fausser	..	70	coke-oven gas
58	Figliini	Soc. Toscana Azoto	N.E.C.	3,150	..	lignite water gas
59	Mas	Soc. Ammonia e Derivati	Fausser	..	3	electrolysis
60	Merano	Soc. Ammonia e Derivati	Fausser	..	100	electrolysis
61	Nera Montoro	Terni St� per l'Industria e l'Elettricit�	Casale	18,000	47	coke-oven gas
62	Novarra	Soc. Ammonia e Derivati	Fausser	..	20	electrolysis
63	San Giuseppe al Cairo	Soc. Ammonia e Derivati	Fausser	28,000	100	electrolysis
64	Terni	Terni St� per l'Industria e l'Elettricit�	Casale	3,000	10	electrolysis
65	Vado Ligure	Azogeno S. A.	Claude	3,000	..	coke-oven gas
66	Verres	Soc. Constr. A. Brambilla	N.E.C.	10,500	..	electrolysis & coke-water gas
JAPAN						
67	Hikoshima	Claude Nitrogen Ind. Co. Ltd.	Claude	3,000	..	coke-water gas
68	Minamata	Nippon Chisso Hiryo K. K.	Casale	36,000	100	electrolysis
69	Miike	Miike Chisso Hiryo	Claude	50,000	..	coke-oven gas
70	Niihama	Sumitomo Fertilizer Works	N.E.C.	87,800	..	coke-water gas
71	Nobeoka	Nippon Chisso Hiryo K. K.	Casale	24,000	62	electrolysis
72	Nogoya	Yahagi Suiryoku K. K.	Mt. Ceniz	84,000	12	electrolysis
74	Toyama	Dai-Nippon Jinzo Hiryo Co.	Fausser	..	70	electrolysis
75	Toyama	Nihon Soda Industrie	Fausser	..	5	electrolysis NaCl
76	Ube	Ube Chisso Kogyo K. K.	Fausser	..	80	coal carbonization & water gas
Note: 3 Haber plants under construction.						
KOREA						
77	Konan	Nippon Chisso Hiryo K.K.	Casale	144,000	480	electrolysis
MANCHUKUO						
78	Dairen	Manch. Chem. Ind. Co.	Mt. Ceniz	..	150	coke-oven gas
NORWAY						
79	Nottoden	Norsk Hydro	N.E.C.	10,000	..	electrolysis
80	Rjukan	Norsk Hydro	Haber	95,500	..	electrolysis
POLAND						
81	Chorzow	Ver. Fab. f. Stickstoffverb.	N.E.C.	10,600	..	coke-water gas
82	Knurow	St� Form. des Mines Fiscales de l'Etat Polonais	Claude	8,500	..	coke-oven gas
83	Tarn�w	Ver. Fab. f. Stickstoffverb.	Fausser	..	100	coke-water gas
84	Wyry	Oswag	N.E.C.	8,711	..	electrolysis & coke-water gas
85	Wyry	Oswag	Fausser	..	25	..
RUMANIA						
86	Dicioanmartin	Nitrogen	Fausser	..	2	electrolysis NaCl
SPAIN						
87	Flix	Sad. Electraquimica	Claude	500	..	byproduct
88	La Felguera	Sad. Iberica del Nitrogeno	Claude	3,000	..	coke-oven gas
89	Sab�nigo	Energ�a & Industrias Aragonesas S. A.	Casale	6,000	15	electrolysis
SWEDEN						
90	Ljunga	Stockholm Superfosfat Fabrik	Fausser	4,500	16	electrolysis
SWITZERLAND						
91	Vi�ge	Lonza Usines Electriques & Chimiques	Casale	9,000	23	electrolysis
UNION OF SOUTH AFRICA						
92	Modderfontein	Imperial Chemical Industries	Haber	7,500	..	coke-water gas
U. S. A.						
93	Belle W. Va.	E. I. Dupont de Nemours	Claude	56,000	..	coke-water gas
94	Belle W. Va.	E. I. Dupont de Nemours	Casale	32,000	106	coke-water gas
95	Hopewell, Va.	Atmospheric Nitrogen Corp.	A.N.C.	200,000	..	coke-water gas
96	Midland, N. T.	Midland Ammonia	F.N.R.L.	2,500	..	byproduct
97	Niagara Falls	E. I. Dupont de Nemours	F.N.R.L.	4,000	..	byproduct
98	Niagara Falls	Mathieson Alkali Works	N.E.C.	7,000	..	byproduct
99	Pittsburg, Cal.	Shell Oil Company	Mt. Ceniz	..	80	cracked natural gas
100	Pittsburg, Cal.	Great Western Electrochemical Co.	Hecker	1,800	..	electrolysis
101	Seattle, Wash.	E. I. Dupont de Nemours	F.N.R.L.	1,000	..	electrolysis
102	Syracuse, N. Y.	Atmospheric Nitrogen Corp.	A.N.C.	10,000	..	coke-water gas
103	Wyandotte, Mich.	Pennsylvania Salt Co.	Mt. Ceniz	..	15	electrolysis NaCl byproduct
U. S. S. R.						
104	Bereniki	Sojuszot	N.E.C.	70,000	..	coke-water gas
105	Stalinogorsk	Sojuszot	N.E.C.	100,000	..	coke-water gas
106	Dzerzhinsk	Sojuszot	Casale	18,000	48	coke-water gas
107	Gorlowka	Trust Kokoabenzol	Fausser	..	100	coke-oven gas

Note: 3 Haber plants under construction.

Table II—World Installation and Capacities for the Production of Synthetic Ammonia by Countries and Processes

(U. S. Tariff Commission data in short tons of Nitrogen.)

Country	Process							National Totals (Tons)	As Percent
	Haber-Bosch	Casale	Fausser	Claude	L.C.I. ¹	N.E.C. ²	Mt. Ceniz		
Germany	880,000	60,500	4,950	38,500	..	49,500	101,200	1,134,650	35.11
United States	33,000	33,000	..	62,000	..	6,200	27,000	333,200	10.31
France	18,400	115,360	..	85,250	..	39,600	19,800	280,760	8.69
Great Britain	3,300	..	..	..	266,200	..	..	269,500	8.34
Japan	..	123,200	11,000	8,550	..	24,200	92,400	259,350	8.02
Belgium	..	82,830	30,250	67,870	..	28,050	..	209,000	6.47
U. S. S. R.	66,000	16,500	29,900	..	..	66,000	..	178,400	5.52
Italy	..	23,100	84,700	7,150	..	7,700	..	122,650	3.80
Netherlands	..	..	102,300	..	..	..	18,700	121,000	3.74
Norway	97,240	..	..	..	..	11,660	..	108,900	3.37
Poland	..	..	41,250	9,350	..	19,250	..	69,850	2.16
Canada	..	2,750	32,450	..	..	..	..	35,200	1.09
Yugoslavia	..	29,700	..	..	..	..	..	29,700	0.92
Czechoslovakia	..	..	..	22,500	..	3,300	..	25,850	0.80
South Africa	..	..	..	..	22,000	..	..	22,000	0.68
Spain	..	6,600	..	3,740	..	..	..	10,340	0.32
Switzerland	..	9,900	..	..	..	..	..	9,900	0.31
Hungary	..	..	..	..	..	6,600	..	6,600	0.20
Sweden	..	..	4,950	..	..	..	..	4,950	0.15
World total—(Tons)	1,064,940	503,440	341,750	304,960	288,200	262,060	259,100	3,231,800	100.00
As percent	32.95	15.58	10.57	9.44	8.92	8.11	8.02	6.19	100.00

ardized. If ten years ago it was difficult to find technically perfected synthetic processes outside of the I.G. and the I.C.I. groups, today it is simplicity of installation, continuity of production and other elements of low operating cost which are most valued.

It is in this latter direction that the collaboration of American engineers has brought interesting results which we may attribute not only to the facilities made available to the technicians of the United States by the Chemical Foundation (the foreign patents) and financial means, but above all to the model creation of the Fixed Nitrogen Research Laboratory and to a training of men admirably adapted to the needs of the new techniques of high pressure and catalysis. In fact, contrary to the habits generalized in most European countries, where a profound distinction is made in the instruction in higher chemistry between the activities of the chemist and the engineer, in America it has been understood that for the kind of work to which we refer, *engineers* must be had possessing a sound knowledge of chemistry. They can dominate a branch of industry in which, besides mechanics and physics, chemistry has a rôle of importance. I refer to American-trained "chemical engineers," who cannot be compared directly with the "engineering chemists," to whom we are generally accustomed in Europe.

Following the local conditions of each country, the composition of the soil, the choice of agricultural products, the meteorological conditions, and so forth, the nitrogen fertilizers used differ considerably and the number of nitrogenous products, and, above all, of mixed and complete fertilizers, increases with a disconcerting rapidity. But, apart from the more or less ephemeral novelties introduced by costly propaganda, we find everywhere the several principal forms in which the major part of nitrogen fertilizers are sold: ammonium sulphate, sodium nitrate—natural and artificial—calcium nitrate, and the different mixed nitrates based on ammonium nitrate, and the complete fertilizers like nitrophoska.

The consumption of the agricultural year 1934-1935 was, according to the Annual Report of the British Sulphate of Ammonia Federation, Ltd., 2,030,861 tons, of which 194,355 tons of Chilean nitrate, and 1,836,506 tons of all other nitrogen products, including byproduct nitrogen, were distributed as shown in Table III.

A comparison of these figures with those indicated above for the production during the same year indicates that equilibrium

has already been established between supply and demand. The International Nitrogen Syndicate (Convention Européenne de l'Industrie de l'Azote—C.I.A.) and above all the D.E.N. group (Deutschland, England, Norge), who, because of the vast size of their factories, preponderate in the C.I.A., have been largely responsible.

As to the table concerning the cyanamide factories, we have not considered it necessary to verify the figures indicated by Dr. Harry A. Curtis for the year 1930 in his book "Fixed Nitrogen," because to our knowledge there have not been notable changes since then in this domain.

The general impression which emerges from the various tables we have just examined is that the crisis which once bid fair to become catastrophic in the domain of the nitrogen industry has been averted, and that if one cannot in a general way encourage new creations in this branch it would be altogether erroneous to conclude that the industry in question had reached a point of stagnation.

It is true that there is still an appreciable discrepancy between the capacity of production and consumption, to the advantage of the former. It must, however, be taken into account that all sorts of barriers, not to mention the extremely important question of transport, have been raised between the various consuming countries; and for this reason, in spite of the abundance of the commodity, the latter may, in certain cases, become inaccessible to purchasers.

In addition, the derivatives of nitrogen being indispensable to the war industry, no country can afford to remain dependent for its supplies, and therefore to the purely economic aspects are added considerations of a very important military character, which necessitates the creation of new factories independent of all other considerations.

Table III—Geographical Distribution of Nitrogen Consumed

(The figures in the following table are also to be taken as estimates only.)

World Consumption of Pure Nitrogen (in Metric Tons)						
Continent	Ammonium Sulphate & Ammonia for mixed Fertilizers	Chile Nitrate	Calcium Cyanamide	Other Synthetic Nitrogen Fertilizers	Nitrogen Products for Industrial Purposes (excl. Chile Nitrate)	Total
Europe.....	448,049	84,112	171,559	398,402	105,589	1,207,711
Africa.....	14,470	23,676	214	32,813	8,055	79,228
Asia.....	277,157	5,351	35,434	19,722	21,568	359,232
Oceania incl. Hawaii.....	16,654	2,081	.....	2,170	1,640	22,545
America.....	124,230	79,135	16,715	49,061	93,004	362,145
World.....	880,560	194,355	223,922	502,168	229,856	2,030,861

We are therefore led to forecast a relatively favorable future development of this branch of industrial activity, with the exception of those countries where existing installations greatly exceed the internal consumption, as for instance in Germany, Norway, Belgium and Holland.

The information given in the tables is derived from the various firms who sell licenses or build factories for nitrogen fixation and we desire to thank them for their courtesy in this connection.

Table IV—Cyanamide Plants of the World

Location	Annual Capacity, Net Tons Nitrogen
Canada	
Niagara Falls.....	80,000
Czechoslovakia	
Karlad.....	6,000
France	
Modane.....	4,000
Brignoud.....	6,000
Marignac.....	6,000
Lannemesan.....	15,000
Bellegarde.....	5,000
Germany	
Trostberg.....	55,000
Piesteritz.....	35,000
Knapsack.....	12,000
Waldshut.....	12,000
Hirshfelde.....	500
Italy	
San Marcel.....	1,100
Domodossola.....	3,300
Colletatte.....	11,000
Narmi.....	3,800
Ascoli Piceno.....	2,200
Japan	
Omura.....	8,800
Omi.....	12,000
Fushiki.....	3,300
Minamota.....	3,300
Taken.....	4,400
Naoetsu.....	8,800
Kagemori.....	8,800
Nogonaka.....	1,600
Namerikoma.....	1,600
Kanose.....	11,000
Jugoslavia	
Sevenico.....	7,000
Almisa.....	7,000
Norway	
Odda.....	15,000
Poland	
Chorzow.....	30,000
Rumania	
Ungar-Altenburg.....	5,000
Sweden	
Alby.....	3,000
Ljunga.....	3,000
Switzerland	
Martigny Ville.....	2,500
Visp.....	2,500
Chèvres.....	small
United States	
Muscle Shoals.....	40,000

[Footnotes for Table II].

¹Process of the Imperial Chemical Industries—a modification of Haber-Bosch.

²Process of the Nitrogen Engineering Corporation.

³Process of the General Chemical Company.

⁴Process of the Fixed Nitrogen Research Laboratory—U. S. Dept. of Agriculture, plant of 5,000 tons included in U. S. total.

⁵Are process—1,250 tons; Jourdan process—1,100 tons included in France total.

Source: Compiled by the Chemical Division of the United States Tariff Commission from various sources, such as *World Trade Notes*, *L'Industrie Chimique*, *Die Chemische Industrie*, etc. Where calculations have been involved a 340-day operating year and an efficiency of 99 percent have been assumed.

Chemical Industry and Engineering in Norway

By E. W. PAULSON
Chemical Engineer, Bergen

BEING a country of less than three million inhabitants, Norway has had to build up her large scale chemical and metallurgical production largely for exports into the world's markets, taking advantage of the country's own supply of certain raw materials, her large resources of water power and last, but not least, her modern engineering skill and equipment. In the following paragraphs the industries concerned will be classified in groups according to their nature.

1. The nitrate industry is represented by the company Norsk Hydro, having a total producing capacity of 650,000 tons (100,000 tons N_2) annually (nitrates of calcium, sodium and ammonia as well as mixed fertilizers and nitric acid). The industry is utilizing a total of 370,000 h.p. of energy in works located in Rjukan, Notodden and Heroya. Of recent progress in this industry must be mentioned the very interesting process of utilizing sea water for the direct conversion of calcium nitrate into sodium nitrate.

2. The electric smelting industries including calcium carbide cyanamide, abrasives and ferro-alloys. The capacity of the Norwegian carbide industry is about 100,000 tons, almost equal to the present world imports, but the production has been heavily curtailed since the war. Exports of carbide from Norway amounted to 33,439 tons in 1935 compared with 34,478 tons of cyanamide, 48,418 tons of ferromanganese, 26,033 tons of ferrosilicon and 11,859 tons of ferrochromium.

Under this group may also be mentioned the recently established production of elemental sulphur from pyrites by the mining company Orkla Gruber. The present plant producing 65,000 tons of sulphur, is now being extended to produce 150,000 tons annually.

3. The electrolytic production of metals. Aluminum is being produced in seven factories, the total capacity of which is about 35,000 tons. Imported alumina is mostly used as raw material. One plant, however, the Hoyanger plant of the Norsk Aluminum Co. is producing its own alumina from bauxite by the electric smelting process of Pedersen, pig iron being a byproduct.

4. Norway has always had a large production of marine oils from her fisheries. In recent time the production of whale oil has been enormously increased by the introduction of the floating factories, working in the Antarctic. A production record was set in 1931 when 25 companies with a fleet of 312,000 gross reg. tons produced 2,317,000 barrels of oil from 26,000 whales. The cod and herring fisheries in home waters is the source of raw material for oils, the export of which amounted to 450,000 hektoliters in 1935, including 100,000 of cod liver medicine oil. Combined with the production of marine oils is that of feed for cattle (export in 1935 of 65,000 tons).

Refining and hardening play an important

part in the Norwegian fat oil industry. In 1935 the export of hydrogenated fats amounted to 38,000 tons.

5. As a fifth group we have the production of chemical wood pulp, partly used in the national paper industry and partly exported (export 1935: 289,000 tons, of which 196,000 bleached sulphite). Great efforts are being made to reach the highest grade of economy and quality in the product, special interest has been attached to the production of raw material for the artificial silk industry.

A large part of Norway's chemical industry has been built up in the last two or three decades. The chemical engineer plays a part of increasing importance in the country's activity today, and on him is resting a large responsibility for the further development of the country's still unused reserves of raw materials and energy. Our chemical engineers are mostly being recruited from Norges Tekniske Høiskole in Trondheim, (Technical University). The scientific and professional interests of chemical engineering are represented by Norsk Kjemisk Selskap (Norwegian Chemical Society) and the Chemical Engineering group of Norsk Ingeniørforening (Federation of Norwegian Engineers). Research institutes of a co-operative nature have been established for the pulp and paper industries.

Cellulose Leads Chemical Industries of Sweden

By OTTO CYREN
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MOST BRANCHES of chemical industry are represented in Sweden, although they are of different magnitude than those of large industrial countries like Great Britain, Germany, and the United States. Unfortunately salt does not occur in Sweden, and the manufacture of heavy chemicals based on it (soda, alkalis, acids, chlorine, etc.) has not played as important a part as elsewhere.

The cellulose industry is the largest chemical industry of Sweden. The manufacture of both sulphate and sulphite pulp—the latter of which is based on Swedish inventions—attracted the early attention of Swedish chemists, and has grown into the largest industry of any kind in the country. As a producer of cellulose, Sweden ranks second only to the United States, but as an exporter she is in first place. The total output in 1935 was 2,265,000 metric tons (1,330,000 tons of sulphite) valued at nearly 300 mill. kronor; the corresponding export figures were 1,787,000 tons (1,031,000 tons of sulphite) and 230 mill. kronor.

The safety match was a Swedish invention, and the industry based on this is one of the oldest in the country. Sweden led the world in this industry, although its subsequent spread to other countries in various parts of the world has since reduced the Swedish exports. Some 19,000 tons (value about 15 mill. kronor) are at present manufactured, of which about 16,000 tons are exported.

The explosives industry is another that Swedish inventors, and chief amongst them Alfred Nobel, have brought to a

high state of development and, thanks to A. Nobel's international connections, it has spread to many countries. The six Swedish factories manufacture dynamite and various kinds of smokeless powders, as well as certain important raw materials and intermediate products. Safety explosives, containing perchlorates and the like, are also manufactured. The product has a total value of about 16 mill. kronor.

Fertilizers and Chemicals. Superphosphate is manufactured in four factories by modern methods largely invented by Swedish engineers. The annual output—more than 200,000 tons (value about 11 mill. kronor)—is sufficient for home requirements and permits some exportation. Sulphuric acid is manufactured in conjunction with superphosphate, and is also exported. Two factories produce fuming sulphuric acid (oleum). Of synthetic nitrogenous fertilizers, calcium cyanamide and synthetic ammonium sulphate (by the Fauser method), etc., are manufactured. This production covers one-third of the home nitrogen requirements. Sodium sulphate, although only a fraction of what is needed by the cellulose industries, hydrochloric acid, nitric acid, and aluminum sulphate—of which a considerable portion is exported—are also Swedish chemicals that are known the world over. Chemical industries are of great importance to the national trade balance, and their joint interests are looked after by the Federation of Swedish Chemical Industries (Sveriges Kemiska Industrikontor).

Recent Developments in the World's Chemical Industry

BY C. C. CONCANNON AND A. H. SWIFT

Chemical Division, Bureau of Foreign and Domestic Commerce

DESIRE FOR self-sufficiency and the need to reduce unemployment actuated the erection of plants for the manufacture of the cheaper grades of medicinals, toiletries and paints several years ago, therefore the number of new plants established in these branches in foreign countries in 1935 was relatively small. Where these industries had been established in prior years and are now operating, they are usually not much more than assembling and packing plants, and account for a marked advance in imports of the necessary materials.

A relatively large number of industrial chemical plants—particularly alkali plants, alcohol distilleries, nitrogenous and other fertilizer factories—were opened or in process of construction in 1935.

A greater utilization of available raw materials in many countries in the manufacture of chemicals for which they had been dependent was very noticeable in 1935.

At least seven new factories for the manufacture of agricultural and technical chemicals not specified and of chemical specialties were established in 1935 or erection contemplated in 1936 in Austria, Belgium, Italy, France, Poland and Turkey.

Tartaric acid is now produced in Czechoslovakia and in Japan, although previously both countries obtained their requirements from abroad. It was reported that Japan is turning out 34 metric tons monthly, yet four other companies expected to be in operation in the near future.

World output of citric acid will be increased by the operation of plants in Poland and Japan, and of lactic acid by new plants in Denmark, Hungary and Czechoslovakia.

In China, on January 1, 1936, the first nitric acid plant went into operation, while in Japan, the continued activity of the explosives, dyestuffs and nitrocellulose industries stimulated the demand for nitric acid and caused a marked increase in production. The recently completed plant at Kawasaki, near Tokyo, has conducted trial operations and also is expected to produce

ammonium nitrate and sodium nitrate. (Estimated 1935 production of nitric acid was 47,000 tons, compared with 43,217 in 1934 and 33,880 in 1933.)

Considerable progress has been made in the development of sulphur supplies in Germany, Sweden, Palestine and Canada, while the Nicaraguan Government has granted to three individuals a concession for sulphur mining at Leon. It is alleged that ore for surface mining contains 20 per cent sulphur and that deposits are within easy reach of the railway. The distance by rail from Leon to the west coast is 35 miles. Sulphur production in Japan increased 18 per cent in 1935 over the 1934 total output of 128,423 and 1933 figure of 104,055 tons. In Newfoundland, plans are being consummated for the resuscitation of the pyrites industry which has not been worked since 1912.

EXPANSION in the sodium compounds group was outstanding, and included plants located in Europe, Asia and North and South America. New plants for the manufacture of soda crystals and soda ash were erected in England, Italy, Irish Free State, Sweden and Manchuria; of sodium acetate in China; sodium phosphate and trisodium phosphate in Poland, France, Japan and Canada; and caustic soda in China, Japan, Canada and Brazil. Although production of caustic soda and other sodium compounds was begun on an experimental scale in a Venezuelan plant, it was uncertain whether the company would be able to turn out marketable products.

The erection of a caustic soda and soda ash factory in Mukden and a caustic soda plant in Dairen were under discussion. It was reported that construction of the government plant in Turkey for the manufacture of caustic soda, chlorine and sulphuric acid would be started in 1936 and its completion in 1937 was contemplated. Foreign interests proposed the establishment of another plant at Sao Paulo, Brazil, to make caustic soda, soda ash and sodium bicarbonate on a large scale.

Production of sodium sulphate was undertaken for the first time in 1935 at

Karabugaz, Russia, where unlimited supplies of salts are continually deposited from the waters of the Caspian Sea.

A plant for the manufacture of sodium cyanide was completed in Japan, while because of its consumption in mining, two concerns in South Africa announced plans for its manufacture in that country.

In Canada, the only producer of magnesium sulphate from natural brines recently resumed operations after the capacity of its plant had been doubled. In India production of epsom salt was proposed.

Liquid hydrogen peroxide was made electrolytically in Canada for the first time in 1935 and arrangements were made to double the Japanese output of hydrogen peroxide.

Expansion in output of other chemicals either by increasing capacity or by erection of new plants was indicated in the Netherlands for hydrochloric acid, in Italy for aluminum sulphate, in Japan for barium sulphate and barium compounds and in Canada for calcium phosphate and uranium salts.

CHANGES in sources of supply for calcium carbide were contemplated in Japan and Chile. The Daido Hiryo KK will produce it to the extent of 50,000 metric tons annually. Plant was expected to be completed this spring and initial output will be at the rate of 35,000 to 40,000 tons, of which 20,000 will be marketed and the remainder used for production of cyanamide. One of the carbide plants in Chile expected to start operating during the first half of 1936 and the other before the end of the year, the capacities being respectively 2,000 and 4,000 tons annually. A British company had under consideration a plan to utilize water of certain Scottish lochs for generating electricity to be used in the manufacture of calcium carbide.

Output of sulphuric acid by erection of new plants was expanded in France, Soviet Russia, Union of South Africa and China; of acetic acid in Soviet Russia and China; of phosphorous salts in Italy; of chlorine in Finland, France,

Italy and Canada; of bismuth compounds in Poland and Sweden and of dextrine in Austria.

Formic and oxalic acid are expected to be made in Japan in June, 1936. Although three Japanese producers of potassium chlorate are reported to be able to supply domestic needs, another company will engage in production, initial output to be absorbed in the company's magnesium works.

Austria reported considerable expansion in capacity of its wood distillation industry and in Japan methanol and formaldehyde were expected to be made in 1936.

NEW plants in the paint industry likewise had world-wide spread, although generally speaking the pigment factories were confined to European countries, with the exception of one establishment in Chile, and the paint factories in China and the Americas. A French company recently started the production of zinc white by the sublimation process at its factory at Viviez in the department of Aveyron. Tyneside, already producing and exporting 40 per cent of the total shipments of zinc oxide from Great Britain to 30 different countries, is to increase its output, and a new company has begun production. Lead oxide and chrome pigment plants were authorized for construction in Italy and Netherlands. Carbon black plants in Czechoslovakia and Rumania started operations.

The first paint plant is about to be erected in Guatemala, the Government having granted a concession for free importation of paint machinery for the purpose of establishing a factory for the production of paint products. Soon the manufacture of nitrocellulose lacquers will be inaugurated in Argentina.

A prominent American manufacturer of enamel for ironware recently formed a subsidiary company in Sao Paulo, Brazil, to manufacture and distribute pigments to be utilized in the manufacture of enameled products.

A plant for the manufacture of glass and paints will be erected in Palestine this year by a British concern. All types of paints, varnishes and lacquers will be made.

A new concern is entering the paint industry in Shanghai, also organized, controlled and managed by British interests. A large modern factory has been started for production of all types of paints, varnishes and lacquers. A Chinese company recently entered into production of lithopone at Shanghai and is now marketing four different grades. Its product is being sold chiefly to Chinese rubber and paint plants.

The German policy to utilize domestic materials wherever possible for imported goods affected the linseed oil

market. Under the reorganized supply measure, linseed oil may be used only for paints for exterior surface which cannot be served acceptably by synthetic substitutes. To meet consumption requirements for other paint and varnish purposes, an entirely new substitute synthetic commodity named "El Firnis" which is understood to contain about 30 per cent pure linseed oil mixed with the synthetic ingredient known as "Alcydal" has been developed. German paint stores also are supplied with colored carbolineum in all colors, including white, and offer paints made from these products as a substitute for linseed oil, for preserving frame houses and for exposed wood constructions.

Tests conducted in Germany have resulted in finding that activated carbon saturated with ammonia possesses valuable rustproofing properties. Combined with linseed oil or any other drying oil as a vehicle, it produces rustproofing paints reported to be fully as effective as red lead paints.

Considerable expansion has taken place in the Brazilian oiticica oil industry and the main producer is erecting another plant.

CONSIDERABLE impetus was given to the coal-tar industry in Italy and in Japan with expansion in capacities for organic intermediates. Italy, Russia and Japan all reported new plants for the manufacture of dyestuffs. In China, a German firm opened a plant at Shanghai for the grinding and packing of dyes in small tins for the retail trade, and an American firm expected to commence similar operations in 1936. Imports of intermediates into both Italy and Japan have been large in recent years. Experiments conducted in Taiwan indicated a possible new outlet for natural camphor in the manufacture of dyes.

The maximum annual output of the projected calcium nitrate plant in Iceland was reported to be 35,000 bags of calcium nitrate and 15,000 bags of compound fertilizer containing nitrogen, phosphoric acid and potash. In May, 1935, manufacture of calcium nitrate was started in France. Another French company also constructed a plant for the manufacture of nitric acid and calcium nitrate. Plans for nitrogen fixation in Egypt at the Assuan Dam are still in the formative stage.

Other European nitrogen projects included expansion in the output of ammonium nitrate and ammonium compounds in Rumania, Russia and Belgium, but the most noteworthy increases were in the Far East, ammonium sulphate, nitrate, chloride, and carbonate plants having been established in Manchuria, Kwangtung, China and Japan, while in India establishment of an am-

monium sulphate factory was projected.

Alongside the superphosphate plant erected by the Reconstruction Division of the Kwangtung Province at Canton now in operation, is being constructed an ammonium sulphate plant by a British firm. At the same location an American firm is building plants for the manufacture of ammonia, nitric acid and ammonium nitrate.

IMPROVEMENT in purchasing power in many foreign countries caused an augmented demand for insecticides and disinfectants, both household and agricultural with consequent increase in manufacturing facilities of arsenic and arsenates in Italy, Sweden and Peru, of copper sulphate in the Netherlands, not only for domestic use but also for exportation. The Chilean Department of Agriculture authorized expenditure of 100,000 pesos for pest or insect control in the department of Quillota. The Public Health Bureau of the Peruvian Government distributed roach-killing powder among the residents of the Lima district. In France, a company was producing an insecticide oil from the distillation of bituminous sulphurous schists in a plant with a daily capacity of one metric ton of oil.

Carbon dioxide held a prominent place with new plants established in Austria, Norway and Canada. In South Africa it was reported that an extensive potential demand exists for solid carbon dioxide and that a firm about to engage in production of alcohol contemplated recovering carbon dioxide for sale in the solid form. In Germany research for new uses continued with a successful one reported to be its use as a rodent exterminator.

Production of sulphur dioxide was begun in Finland and pure sulphur dioxide is recovered from waste gases in Hamburg, Germany, by a process developed jointly by Gesellschaft für Chemische Industrie, Basle, and the Metallgesellschaft, Frankfurt-on-Main. The Hamburg plant utilizes waste gases with an average sulphur dioxide content of 3.6 per cent and its successful operation has led to construction of a plant at a foreign lead smelter for a daily recovery of 30 tons of sulphur dioxide from roaster gases of 4 per cent content.

In Canada, an experimental plant was to be established for the manufacture of hydrogen and oxygen. From Brazil came the report that a request was made by the company operating the Graf Zeppelin between Germany and Brazil for authorization of the Minister of Transportation to sell in Brazil oxygen produced in connection with the manufacture of hydrogen at the Brazilian airport plant able to produce 200 cubic meters of hydrogen hourly.

Electrochemical Society Elects New Officers

AT THE Annual Meeting of the Electrochemical Society held in Cincinnati, Ohio, on April 22-25, Dr. Duncan A. MacInnes of the Rockefeller Institute for Medical Research, New York, was elected president of the Society. The three new vice-presidents are H. Jermain Creighton, S. D. Kirkpatrick and R. R. Ridgway. The three new managers are M. A. Hunter, F. A. Lidbury and E. C. Sprague. Dr. Robert M. Burns was reelected treasurer, and Colin G. Fink, secretary.

Honorary membership in the Society was awarded to Dr. L. H. Baekeland, of the Bakelite Company, a past president of the Society, an active and enthusiastic member for over thirty years, a foremost chemist and engineer whose many basic inventions have contributed largely to the high stage of development of the electrochemical, chemical and electrical industries. Presentation of the illumined certificate of honorary membership took place on Friday evening, April 24.

The eighth Weston Fellowship of \$1,000 was given to Dr. Henry B. Linford of Pullman, Wash. Dr. Linford will continue his studies on the electrochemical properties of the elements of the fourth group in the periodic table, the work to be done under the direction of Prof. Colin G. Fink at Columbia University.

Canadian Chemists Will Meet at Niagara Falls

THE Niagara District Chemical and Industrial Association which will act as the host group for the Canadian Chemists' Convention, are making arrangements for an interesting and pleasant meeting of the Canadian chemists at Niagara Falls for three days starting June 9.

This convention is a general meeting of the Canadian Chemical Association, and the Canadian Institute of Chem-

istry, and both organizations are drawing up interesting programs.

Dr. C. E. K. Mees of the Eastman Kodak Co. will give an illustrated lecture on "Color Photography and the Kodachrome Process." Louis Blake Duff, eminent historian of the Niagara Falls district, will speak at the Tuesday luncheon. Dr. Billings of the Hercules Powder Co. will give an address on "The Training of Men for Research Work." Other speakers will be Dr. Gunton of the University of Western Ontario, and Professor Beamish.

The Industrial Engineering section is arranging a sectional program. Talks will be given on rayon, Duprene, chemical engineering equipment, refractory mixes, and other subjects.

The Canadian Institute of Chemistry will hold its main meeting on Wednesday. Divisional programs are also being arranged by the Educational Section, the Bio-Chemical Section, the Foods and Cereals Section, and the Pure Chemistry Section.

Government Will Lend Rosin Standards

AMENDED regulations under the Federal Naval Stores Act were approved by the Secretary of Agriculture, on April 21, effective May 1. These regulations are entitled "Loan and Care of Duplicates of United States Standards." They give the terms under which sets of duplicates of the United States Standards for rosin will be issued on loan by the Department of Agriculture to "interested persons" having a genuine need for same. They may be lent to Federal, State or other official naval stores inspectors who are recognized by the Department of Agriculture as having been properly appointed under competent authority; to certain bona fide naval stores dealers and distributors who operate recognized naval stores yards serving the public; and to others who make use of the duplicates in their business.

The latter are required to post \$100 cash security which will be returned when the duplicates are returned in good condition.

Fertilizer Men To Discuss Industry Planning

TWELFTH annual convention of The National Fertilizer Association will be held at White Sulphur Springs, W. Va., June 8-10. The 1935 convention was held shortly after the Supreme Court decided the case invalidating NRA codes. At that convention the industry began to develop a plan for self-government which would provide, through voluntary action, for eliminating unethical and disastrous business practices.

Following the convention last June, meetings were held throughout the country as a result of which a group of fair trade practice rules was prepared and submitted to the Federal Trade Commission for approval.

It is expected that the convention program this year will be devoted very largely to a further discussion of industry planning and to the formulation of definite methods of procedure.

Asphalt Institute Elects Officers

AT its annual meeting held in New York the board of directors of the Asphalt Institute elected the following officers: B. L. Boye, of the Socony-Vacuum Oil Co.; vice-presidents, J. A. Blood, of the Standard Oil Co. of California, Leroy M. Law, of the Shell Petroleum Corp., T. M. Martin, of the Lion Oil Refining Co., and A. M. Maxwell, of the Standard Oil Co. of Ohio; chairman of the executive committee, C. W. Bayliss, of the Barber Asphalt Co.; treasurer, Herbert Spencer, of the Standard Oil Co. of New Jersey; secretary, J. J. Gartland, of the Texas Co.; managing director, J. E. Pennybacker.

London Chemical Club Extends Privileges

AT a meeting held on April 20, the executive committee of the Chemical Club of London decided to extend the privileges of temporary membership to all those attending the Chemical Engineering Congress, which will be held at the Central Hall, Westminster, London, S.W.1, on June 22-27. The necessary cards for temporary membership, which are available for one month, may be obtained on application to the secretary of the club, 2 Whitehall Court, London, S.W.1.

TARIFFS affecting chemical industry were spotlighted by bitter partisan controversy in the Senate late in April. As a result, the U. S. Tariff Commission has been ordered to report the names of manufacturing corporations having statutory net incomes of \$1 million or more "producing commodities protected by the tariff, the rates of duty on principal commodities produced by each, and the 1934 selling prices derived from general sources of such commodities." Also the Commission is supposed to determine and inform the Senate as to the effect of tariff on selling prices of these goods and the benefits to the companies which have resulted from the existence of tariffs.

More specifically, nine groups of producers are singled out for special attention. With respect to each group, the Senate asks the Commission to identify and report the names of "the three corporations or factories which did the largest gross business during the calendar year 1934, in the production and manufacturing of the following tariff-protected articles and commodities: (1) Aluminum; (2) steel and iron; (3) photo cameras and films; (4) chemicals and dyes; (5) electric appliances and equipment; (6) cellophane and rayon; (7) plate glass; (8) cast-iron pipe and fittings; (9) articles or wares manufactured of tin."

MODERNIZATION of tank car specifications is definitely under way with I.C.C. cooperation. During the past month that body has reconsidered and approved several long-pending applications for the use of welded construction on tank cars of various types. One authorization covers the experimental-service use of 25 welded cars to be employed for petroleum products. The second approval gives like authority for a new type of welded construction on special alloys resistant to nitric acid. The third case provides specifically for 25 cars to be used in handling propane. This group and the other group of 25 are both under the general provision of I.C.C. Specification 105A; but the two groups differ in that one provides for 300 pounds hydraulic test and the other for 400 pounds.

The first major advance in construction of high-pressure gas cylinders of I.C.C. Type 3A which has been made in many years, was also authorized late in April. Under the new order such cylinders may be designed without regard to the old limit which forbade designs involving stresses above 70 per cent of yield point. Waiver of this provision is contingent on the use of high quality alloy steels of the SAE Type 4130X. This molybdenum treated chrome-manganese steel will, it is be-

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Paul Wooton, Chief

lieved, greatly reduce the likelihood of fragmentation in the event of rupture or penetration of these cylinders. Thus any hazard resulting from breakage of cylinders, as during railway wrecks, would be localized. Under other circumstances the type of alloy steel authorized will equal or better in performance the types formerly required for 3A cylinders.

A SECOND conference of trade association executives with the Secretary of Labor was held on April 14, further to plan the study and correction of the silicosis problem of the country. After very full discussion, the conference decided to name four committees, whose functions are clearly indicated by the following titles: Prevention of silicosis through medical control; prevention of silicosis through engineering control; economic, legal, and insurance phases of the silicosis problem; and regulatory and administrative phases of the silicosis problem.

It is expected that those committees will carry on their investigations during the next three to six months after which the reports will be presented at a large national gathering from which it is hoped, a great educational benefit can come. Spokesmen of 36 industries, representing well over a million workers who are believed in some degree subject to possible dust hazards, are cooperating.

This arrangement, to have committee investigations during the coming Summer, defers the controversy which appeared to be brewing between Miss Perkins, secretary of labor, and Miss Roche, assistant secretary of treasury, in charge of Public Health Service. Cooperation in education, therefore, is hoped for by those who seek some constructive influence from Washington.

Investigations of the Bureau of Mines on hydrogenation of coal are continuing with new equipment provided for enlargement of experimental

activities in Pittsburgh. The effort is to make fundamental studies on which sound economic analysis may be made of the methods proposed for use with various types of American coals. A long-time program is contemplated, without effort to encourage early commercialization. The Bureau believes that much new information is needed as to what products may be made under different conditions and which coals will lend themselves best to this development. "It may take years to get such data; and it is desirable to start research now, even though substitution of coal for petroleum may not come for years."

The new equipment which has been designed by the Bureau staff provides for the processing of 150 to 250 pounds of coal per 24 hours. The earlier work will be directed to the study of both lubricants and motor fuels as end products. Cooperation with Canadian research of like nature is contemplated.

Users of coconut oil lost the first round in their battle to escape processing taxes on imported coconut oil. The Supreme Court of the District of Columbia ruled late in April that Congress has a right to levy such tax "which is in the nature of an import duty" and that predetermination that the money should go to the Philippine treasury does not in any way reduce the legality of the levy. Appeal is being taken and final settlement is not expected until the Supreme Court of the United States has announced its opinion. In the meantime, all users pay the taxes, generally under protest, and the proposals for substitute legislation gather dust in Congressional pigeon-holes.

The plaintiff attacked the act on the grounds: First: That the enactment of Sec. 602½ is an attempt on the part of Congress to regulate the price of and increase the demand for domestic fats and oils; that this is not within the scope of powers granted to Congress by the Constitution either in the commerce clause or elsewhere; and that such regulation is one that is reserved to the States by the Tenth Amendment.

Second: That where, as here, an exaction, although styled a tax, appears upon the face of the statute to be nothing but an unconstitutional scheme to raise the price of and increase the demand for domestic fats and oils, the levy is not an exercise of the taxing power of Congress.

Third: That even if the exaction can be considered as an exercise of the taxing power, it is such an exercise as is prohibited by the Fifth Amendment, because the raising of money for the benefit of the Philippine Islands is not taxation for a public purpose.

Current

PRICES

The following prices refer to round lots in the New York market. Where it is the trade custom to sell f.o.b. works, quotations are given on that basis and are so designated. Prices are corrected to May 12.

Industrial Chemicals

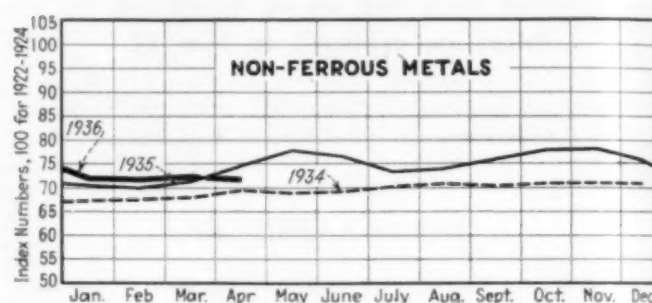
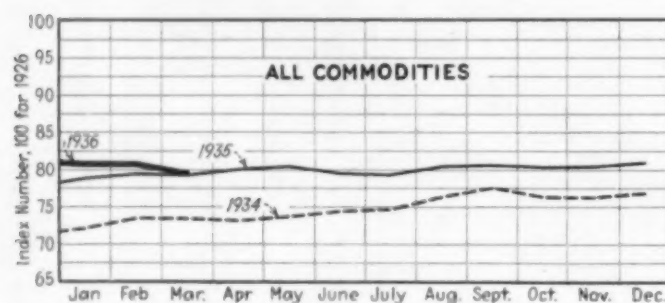
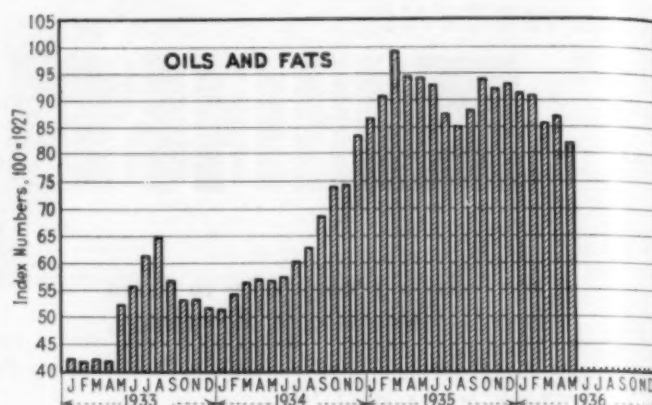
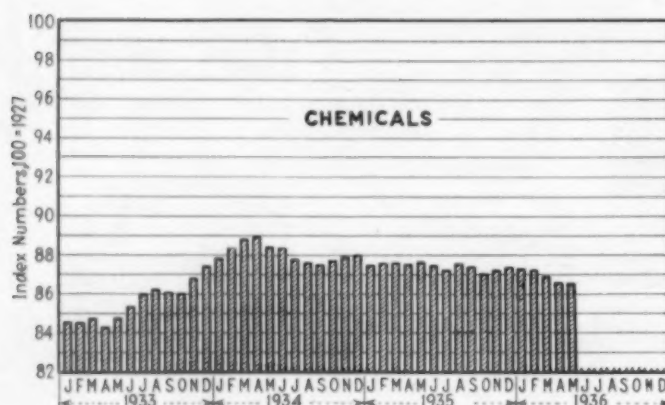
	Current Price	Last Month	Last Year
Acetone, drums, lb.	\$0.091-\$0.10	\$0.091-\$0.10	\$0.12-\$0.12½
Acid, acetic, 28%, bbl., cwt.	2.45-2.70	2.45-2.70	2.45-2.70
Glacial 99%, drums	8.43-8.68	8.43-8.68	8.43-8.68
U. S. P. reagent	10.52-10.77	10.52-10.77	10.52-10.77
Boric, bbl., ton.	105.00-115.00	105.00-115.00	95.00-105.00
Citric, kegs, lb.	.27-.30	.28-.31	.28-.31
Formic, bbl., ton.	.11-.11½	.11-.11½	.11-.11½
Gallic, tech., bbl., lb.	.60-.65	.60-.65	.60-.65
Hydrofluoric 30% carb., lb.	.07-.07½	.07-.07½	.07-.07½
Lactic, 44%, tech., light, bbl., lb.	.11½-.12	.11½-.12	.12-.12½
22%, tech., light, bbl., lb.	.06½-.07	.06½-.07	.06½-.07
Muriatic, 18%, tanks, cwt.	1.00-1.10	1.00-1.10	1.00-1.10
Nitric, 36%, carboys, lb.	.05-.05½	.05-.05½	.05-.05½
Oleum, tanks, wks., ton.	18.50-20.00	18.50-20.00	18.50-20.00
Oxalic, crystals, bbl., lb.	.11½-.12½	.11½-.12½	.11½-.12½
Phosphoric, tech., c'bya., lb.	.09-.10	.09-.10	.09-.10
Sulphuric, 60%, tanks, ton.	11.00-11.50	11.00-11.50	11.00-11.50
Sulphuric, 66%, tanks, ton.	15.50-16.00	15.50-16.00	15.50-16.00
Tannic, tech., bbl., lb.	.23-.35	.23-.35	.23-.35
Tartaric, powd., bbl., lb.	.24-.25	.24-.25	.24-.25
Tungstic, bbl., lb.	1.50-1.60	1.50-1.60	1.40-1.50
Alcohol, Amyl.			
From Pentane, tanks, lb.	14.3	15	15
Alcohol, Butyl, tanks, lb.	.08½	.09½	.13
Alcohol, Ethyl, 190 p.f., bbl., gal.	4.27½	4.27½	4.27½
Denatured, 190 proof.			
No. 1 special, dr., gal.	.34	.34	.36
Alum, ammonia, lump, bbl., lb.	.03-.04	.03-.04	.03-.04
Chrome, bbl., lb.	.04½-.05	.04½-.05	.04½-.05
Potash, lump, bbl., lb.	.03½-.04	.03½-.04	.03½-.04
Aluminum sulphate, com., bags cwt.	1.35-1.50	1.35-1.50	1.35-1.50
Iron free, bg., cwt.	2.00-2.25	2.00-2.25	1.90-2.00
Aqua ammonia, 26%, drums, lb.	.02½-.03	.02½-.03	.02½-.03
tanks, lb.	.02½-.02½	.02½-.02½	.02½-.02½
Ammonia, anhydrous, cyl., lb.	.15-.16	.15-.16	.15-.16
tanks, lb.	.04½	.04½	.04½
Ammonium carbonate, powd.			
tech., caaks, lb.	.08-.12	.08-.12	.08-.12
Sulphate, wks., cwt.	1.25-1.35	1.25-1.35	1.20-1.25
Amylacetate tech., tanks, lb.	.12-.135	.12-.135	.142
Antimony Oxide, bbl., lb.	.13½-.14	.13½-.14	.11½-.12
Arsenic, white, powd., bbl., lb.	.03½-.04	.03½-.04	.03½-.04
Red, powd., kegs, lb.	.15½-.16	.15½-.16	.15½-.16
Barium carbonate, bbl., ton.	56.50-58.00	56.50-58.00	56.50-58.00
Chloride, bbl., ton.	72.00-74.00	72.00-74.00	72.00-74.00
Nitrate, caak, lb.	.08½-.09	.08½-.09	.08½-.09
Blanc fixe, dry, bbl., lb.	.03½-.04	.03½-.04	.03½-.04
Bleaching powder, f.o.b., wks. drums, cwt.	2.00-2.10	2.00-2.10	1.90-2.00
Borax, gran., bags, ton.	44.00-49.00	44.00-49.00	40.00-45.00
Bromine, ca., lb.	.36-.38	.36-.38	.36-.38
Calcium acetate, bags	2.10-2.10	2.10-2.10	2.10-2.10
Arsenate, dr., lb.	.06-.07	.06-.07	.06-.07
Carbide drums, lb.	.05-.06	.05-.06	.05-.06
Chloride, fused, dr., del., ton.	20.00-33.00	20.00-33.00	20.00-33.00
flake, dr., del., ton.	22.00-35.00	22.00-35.00	22.00-35.00
Phosphate, bbl., lb.	.07½-.08	.07½-.08	.07½-.08
Carbon bisulphide, drums, lb.	.05½-.06	.05½-.06	.05½-.06
Tetrachloride drums, lb.	.05½-.06	.05½-.06	.05½-.06
Chlorine, liquid, tanks, wks., lb.	2.15-.06	2.15-.06	2.00-.06
Cylinders	.05½-.06	.05½-.06	.05½-.06
Cobalt oxide, cans, lb.	1.41-1.51	1.29-1.35	1.25-1.35
Copperas, bags, f.o.b., wks., ton.	15.00-16.00	15.00-16.00	14.00-15.00

	Current Price	Last Month	Last Year
Copper carbonate, bbl., lb.	.08½-.16	.08½-.16	.08½-.16
Cyanide, tech., bbl., lb.	.37-.38	.37-.38	.37-.38
Sulphate, bbl., cwt.	4.00-4.25	3.85-4.00	3.85-4.00
Cream of tartar, bbl., lb.	.16½-.17	.16½-.17	.16½-.17
Diethylene glycol, dr., lb.	.16½-.20½	.16½-.20½	.16½-.20½
Epsom salt, dom., tech., bbl., cwt.	1.80-2.00	1.80-2.00	2.10-2.15
Imp., tech., bags, cwt.	2.00-2.10	2.00-2.10	2.00-2.10
Ethyl acetate, drums, lb.	.07-.07½	.07½-.08	.08½-.09
Formaldehyde, 40%, bbl., lb.	.06-.07	.06-.07	.06-.07
Furfural, dr., contact, lb.	.10-.17½	.10-.17½	.10-.17½
Fusel oil, ref. drums, lb.	.16-.18	.16-.18	.16-.18
Glaucous salt, bags, cwt.	.85-1.00	.85-1.00	1.00-1.10
Glycerine, c.p., drums, extra, lb.	.14½-.15	.14½-.15	.14-.14½
Lead:			
White, basic carbonate, dry caaks, lb.	.06½-	.06½-	.06½-
White, basic sulphate, sk., lb.	.06-	.06-	.06-
Red, dry, sk., lb.	.07-	.07-	.07-
Lead acetate, white crys., bbl., lb.	.10½-.11	.10½-.11	.10½-.11
Lead arsenate, powd., bbl., lb.	.07-.10	.09-.10	.09-.10
Lime, chem., bulk, ton.	8.50-	8.50-	8.50-
Litharge, powd., sk., lb.	.06-	.06-	.05½-
Lithophone, bags, lb.	.04½-.05	.04½-.05	.04½-.05
Magnesium carb., tech., bags, lb.	.06-.06½	.06-.06½	.06-.06½
Methanol, 95%, tanks, gal.	.33-	.33-	.33-
97%, tanks, gal.	.34-	.34-	.34-
Synthetic, tanks, gal.	.35½-	.35½-	.35½-
Nickel salt, double, bbl., lb.	.13-.13½	.13-.13½	.12½-.13
Orange mineral, sk., lb.	.10-	.10-	.09½-.45
Phosphorus, red, cases, lb.	.44-.45	.44-.45	.44-.45
Yellow, cases, lb.	.28-.32	.28-.32	.28-.32
Potassium bichromate, caaks, lb.	.08½-.09	.08½-.09	.07½-.08½
Carbonate, 80-85%, calc. sk., lb.	.07-.07½	.07-.07½	.07-.07½
Chlorate, powd., lb.	.08-.08½	.08-.08½	.08½-.09
Hydroxide (caustic potash) dr., lb.	.06½-.06	.06½-.06	.06½-.06
Muriate, 80% bags, ton.	23.00-	23.00-	22.00-
Nitrate, bbl., lb.	.05½-.06	.05½-.06	.05½-.06
Permanganate, drums, lb.	.18½-.19	.18½-.19	.18½-.19
Prussiate, yellow, caaks, lb.	.18-.19	.18-.19	.18-.19
Sai ammoniac, white, caaks, lb.	.04½-.05	.04½-.05	.04½-.05
Salsoda, bbl., cwt.	1.00-1.05	1.00-1.05	1.00-1.05
Salt cake, bulk, ton.	13.00-15.00	13.00-15.00	13.00-15.00
Soda ash, light, 58%, bags, contract, cwt.	1.23-	1.23-	1.23-
Dense, bags, cwt.	1.25-	1.25-	1.25-
Soda, caustic, 76%, solid, drums, contract, cwt.	2.60-3.00	2.60-3.00	2.60-3.00
Acetate, works, bbl., lb.	.04½-.05	.04½-.05	.04½-.05
Bicarbonate, bbl., cwt.	1.85-2.00	1.85-2.00	1.85-2.00
Bichromate, caaks, lb.	.06½-.07	.06½-.07	.05½-.06½
Bisulphate, bulk, ton.	15.00-16.00	15.00-16.00	14.00-16.00
Bisulphite, bbl., lb.	.03½-.04	.03½-.04	.03-.04
Chlorate, kegs, lb.	.06½-.06	.06½-.06	.06½-.06
Chloride, tech., ton.	12.00-14.75	12.00-14.75	12.00-14.75
Cyanide, cases, dom., lb.	.15½-.16	.15½-.16	.15½-.16
Fluoride, bbl., lb.	.07½-.08	.07½-.08	.07½-.08
Hyposulphite, bbl., lb.	2.40-2.50	2.40-2.50	2.40-2.50
Metasilicate, bbl., cwt.	2.90-3.00	2.90-3.00	3.25-3.40
Nitrate, bags, cwt.	1.325-	1.325-	1.275-
Nitrite, caaks, lb.	.07½-.08	.07½-.08	.07½-.08
Phosphate, dibasic, bbl., lb.	.022-.023	.022-.023	.022-.024
Prussiate, yel. drums, lb.	.11½-.12	.11½-.12	.11½-.12
Silicate (40% dr.) wks., cwt.	.80-.85	.80-.85	.80-.85
Sulphide, fused, 60-62%, dr., lb.	.02½-.03½	.02½-.03½	.02½-.03
Sulphite, cyrs., bbl., lb.	.02½-.02½	.02½-.02½	.02½-.02½
Sulphur, crude at mine, bulk, ton.	18.00-	18.00-	18.00-
Chloride, dr., lb.	.03½-.04	.03½-.04	.03½-.04
Dioxide, cyl., lb.	.06½-.08	.06½-.08	.07-.07½
Flour, bag, cwt.	1.60-3.00	1.60-3.00	1.60-3.00
Tin Oxide, bbl., lb.	.51-	.51-	.53-
Crystals, bbl., lb.	.36-	.37½-	.38-
Zinc chloride, gran., bbl., lb.	.05-.06	.05-.06	.05½-.06
Carbonate, bbl., lb.	.09-.11	.09-.11	.09-.11
Cyanide, dr., lb.	.36-.38	.36-.38	.369-.38
Dust, bbl., lb.	.069-.07	.069-.07	.05-.07
Zinc oxide, lead free, bag, lb.	.05-	.05-	.05½-
5% lead sulphate, bags, lb.	.04½-	.04½-	.05½-
Sulphate, bbl., cwt.	2.65-3.00	2.65-3.00	2.75-3.00

Oils and Fats

	Current Price	Last Month	Last Year
Castor oil, No. 3, bbl., lb.	\$0.10-\$0.11	\$0.10-\$0.11	\$0.09½-\$0.10
Chinawood oil, bbl., lb.	.18½-	.19-	.17-
Cocoonut oil, Ceylon, tanks, N. Y. lb.	.04-	.04½-	.05½-
Corn oil crude, tanks, (f.o.b. mill), lb.	.08½-	.08½-	.08½-
Cottonseed oil, crude (f.o.b. mill), tanks, lb.	.07½-	.08½-	.09½-
Linseed oil, raw ear lots, bbl., lb.	.09½-	.09½-	.09½-
Palm, caaks, lb.	.04½-	.04½-	.04½-
Palm kernel, bbl., lb.	.05½-	.05½-	nom.
Peanut oil, crude, tanks (mill), lb.	.07½-	.08½-	.09½-
Rapeseed oil, refined, bbl., gal.	.52-	.53-	.43-
Soya bean, tank, lb.	.07½-	.08-	.09-
Sulphur (olive foot), bbl., lb.	.08-	.08-	.08½-
Cod, Newfoundland, bbl., gal.	.40-	.40-	.33-
Menhaden, light pressed, bbl., lb.	.062-	.066-	.069-
Crude, tanks (f.o.b. factory), gal.	.34-	.34-	.30-
Grease, yellow, loose, lb.	.03½-	.04½-	.05½-
Oleo stearine, lb.	.07½-	.08-	.09½-
Red oil, distilled, d.p. bbl., lb.	.09½-	.09½-	.09½-
Tallow, extra, loose, lb.	.04½-	.05½-	.06½-

CHEM. & MET.'S WEIGHTED PRICE INDEXES



Coal-Tar Products

	Current Price	Last Month	Last Year
Alpha-naphthol, crude, bbl., lb.	\$0.60 - \$0.65	\$0.60 - \$0.65	\$0.60 - \$0.62
Refined, bbl., lb.	.80 - .85	.80 - .85	.80 - .85
Alpha-naphthylamine, bbl., lb.	.32 - .34	.32 - .34	.32 - .34
Aniline oil, drums, extra, lb.	.14 - .15	.14 - .15	.14 - .15
Aniline salts, bbl., lb.	.24 - .25	.24 - .25	.24 - .25
Benzaldehyde, U.S.P., dr., lb.	1.10 - 1.25	1.10 - 1.25	1.10 - 1.25
Benzidine base, bbl., lb.	.65 - .67	.65 - .67	.65 - .67
Benzoic acid, U.S.P., kgs., lb.	.48 - .52	.48 - .52	.48 - .52
Benzyl chloride, tech., dr., lb.	.30 - .35	.30 - .35	.30 - .35
Benzol, 90%, tanks, works, gal.	.18 - .20	.18 - .20	.15 - .16
Beta-naphthol, tech., drums, lb.	.24 - .27	.24 - .27	.22 - .24
Cresol, U.S.P., dr., lb.	.11 - .11	.11 - .11	.11 - .11
Cresylic acid, 99%, dr., wks., gal.	.58 - .60	.58 - .60	.50 - .51
Diethylaniline, dr., lb.	.55 - .58	.55 - .58	.55 - .58
Dinitrophenol, bbl., lb.	.29 - .30	.29 - .30	.29 - .30
Dinitrotoluene, bbl., lb.	.16 - .17	.16 - .17	.16 - .17
Dip oil, 25%, dr., gal.	.23 - .25	.23 - .25	.23 - .25
Diphenylamine, bbl., lb.	.38 - .40	.38 - .40	.38 - .40
H-acid, bbl., lb.	.65 - .70	.65 - .70	.65 - .70
Naphthalene, flake, bbl., lb.	.07 - .07	.07 - .07	.05 - .06
Nitrobenzene, dr., lb.	.08 - .09	.08 - .09	.08 - .10
Para-nitraniline, bbl., lb.	.51 - .55	.51 - .55	.51 - .55
Phenol, U.S.P., drums, lb.	.14 - .15	.14 - .15	.14 - .15
Picric acid, bbl., lb.	.30 - .40	.30 - .40	.30 - .40
Pyridine, dr., gal.	1.10 - 1.15	1.10 - 1.15	1.10 - 1.15
Resorcinol, tech., kgs., lb.	.65 - .70	.65 - .70	.65 - .70
Salicylic acid, tech., bbl., lb.	.40 - .42	.40 - .42	.40 - .42
Solvent naphtha, w.w., tanks, gal.	.26 - .26	.26 - .26	.26 - .26
Tolidine, bbl., lb.	.88 - .90	.88 - .90	.88 - .90
Toluene, tanks, works, gal.	.30 - .30	.30 - .30	.30 - .30
Xylene, com., tanks, gal.	.30 - .30	.30 - .30	.30 - .30

Miscellaneous

	Current Price	Last Month	Last Year
Barytes, grid., white, bbl., ton.	\$22.00 - \$25.00	\$22.00 - \$25.00	\$22.00 - \$25.00
Casein, tech., bbl., lb.	.14 - .16	.14 - .16	.12 - .13
China clay, dom., f.o.b. mine, ton	8.00 - 20.00	8.00 - 20.00	8.00 - 20.00
Dry colors:			
Carbon gas, black (wks.), lb.	.04 - .20	.04 - .20	.04 - .20
Prussian blue, bbl., lb.	.37 - .38	.37 - .38	.35 - .37
Ultramarine blue, bbl., lb.	.10 - .26	.10 - .26	.06 - .32
Chrome green, bbl., lb.	.26 - .27	.26 - .27	.26 - .27
Carmine red, tins, lb.	4.00 - 4.40	4.00 - 4.40	4.00 - 4.40
Para toner, lb.	.80 - .85	.80 - .85	.80 - .85
Vermilion, English, bbl., lb.	1.59 - 1.60	1.59 - 1.60	1.56 - 1.60
Chrome yellow, C. P., bbl., lb.	.12 - .14	.12 - .14	.15 - .15
Feldspar, No. 1 (f.o.b. N.Y.), ton.	6.50 - 7.50	6.50 - 7.50	6.50 - 7.50
Graphite, Ceylon, lump, bbl., lb.	.07 - .08	.07 - .08	.07 - .08
Gum copal Congo, bags, lb.	.09 - .10	.09 - .10	.09 - .10
Manila, bags, lb.	.09 - .10	.09 - .10	.16 - .17
Damar, Batavia, cases, lb.	.15 - .16	.15 - .16	.16 - .16
Kauri No. 1 cases, lb.	.20 - .25	.20 - .25	.20 - .25
Kieselguhr (f.o.b. N.Y.), ton.	50.00 - 55.00	50.00 - 55.00	50.00 - 55.00
Magnetite, calc, ton.	50.00 - .	50.00 - .	40.00 - .
Pumice stone, lump, bbl., lb.	.05 - .07	.05 - .08	.05 - .07
Imported, caaks, lb.	.03 - .40	.03 - .40	.03 - .35
Rosin, H., bbl.	5.50 - .	5.70 - .	5.75 - .
Turpentine, gal.	.42 - .	.43 - .	.52 - .
Shellac, orange, fine, bags, lb.	.25 - .	.25 - .	.27 - .
Bleached, bonedry, bags, lb.	.19 - .	.19 - .	.21 - .
T. N. bags, lb.	.14 - .	.14 - .	.14 - .
Soapstone (f.o.b. Vt.), bags, ton.	10.00 - 12.00	10.00 - 12.00	10.00 - 12.00
Talc, 200 mesh (f.o.b. Vt.), ton.	8.00 - 8.50	8.00 - 8.50	8.00 - 8.50
300 mesh (f.o.b. Ga.), ton.	7.50 - 10.00	7.50 - 10.00	7.50 - 11.00
225 mesh (f.o.b. N.Y.), ton.	13.75 - .	13.75 - .	13.75 - .

CHEM. & MET. Weighted Index of CHEMICAL PRICES

Base = 100 for 1927	
This month	86.38
Last month	86.67
May, 1935	87.62
May, 1934	88.46

With most chemicals holding a steady position, the solvent group has offered an exception and brought the index number down.

NEW CONSTRUCTION

Where Plants Are Being Built in
Process Industries

	Current Projects	Proposed Work	Contracts
New England		\$140,000	
Middle Atlantic	\$1,611,000	1,751,000	
South	540,000	304,000	
Middle West	1,476,000	704,000	
West of Mississippi		124,000	
Far West	375,000	100,000	
Canada	1,400,000	8,037,000	
Total	\$5,396,000	\$11,160,000	

CHEM. & MET. Weighted Index of Prices for OILS AND FATS

Base = 100 for 1927	
This month	82.13
Last month	87.01
May, 1935	94.14
May, 1934	56.94

Price declines were fairly general throughout the oil and fats list. Crude cottonseed oil dropped one-half cent a lb. during the month.